Installation Instructions

Allen-Bradley

CENTERLINE 2100 Low Voltage Motor Control Centers

Catalog Numbers 2100

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Allen-Bradley, Rockwell Software, Rockwell Automation, ArcShield, and CENTERLINE are trademarks of Rockwell Automation, Inc.

Trademarks not belonging to Rockwell Automation are property of their respective companies.

This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

New and Updated Information

This table contains the changes made to this revision.

Topic	Page
Added instructions for replacing Bulletin 140G circuit breakers.	Appendix A
Added instructions for installing auxiliary contact adapters.	Appendix B

Notes:

Preface

About This Publication 9
Additional Resources 9
Purchased Components and Additional Instruction Sheets 10

Chapter 1

General Information

General Description 11
Nameplate Data 12
MCC Sequence Numbering 13
UL/CSA Marking 14
Short-circuit Rating Label 15
ArcShield Rating Labels 16
Series Number and Series ID as Manufactured in the United States . . 16
Series Lettering - Units and Sections 19
Receiving, Handling, and Storage 21
Receiving 21
Handling 22
Storage and Operation 23

Chapter 2

Installation Procedures

Location Planning 25
Height Considerations 25
ArcShield Clearance Height 26
Securing an MCC 26
Seismic Requirements 38
Joining and Splicing New MCCs 39
Joining and Splicing Existing MCCs 39
Joining and Splicing MCCs with ArcShield 40
Installing and Joining Pull Boxes 40
Joining and Splicing NEMA Type 12 MCCs 40
Joining and Splicing NEMA Type 3R and Type 4 MCCs 40
Bus Torque Specifications 42

Chapter 3

Installing Conduit and Cable

Installing Conduit 43
Bottom Entry Conduit 43
Top Entry Conduit 43
Installing Cable 44
Lugs 44
Incoming Line Compartment 45
Main Disconnect 45
Cable Bracing 45
Incoming Line Brace 47

Chapter 4

Installing and Removing Plug-in Units

Installing Plug-in Units 49
Remove a SecureConnect Unit from a Section 50
Remove a Plug-in Unit with a Vertical Operating Handle from a Section 51
Remove a Plug-in Unit with a Horizontal Operating Handle from a Section 57
Remove the Support Pan 62

Chapter 5

Arc Flash Protection Marking as Required by the National Electrical Code

Flash Protection Marking Requirement 65
110.16 Flash Protection 65
Arc Flash Marking Clarification 66
Rockwell Automation Services 66

Chapter 6

Operator Handle and Unit Interlock

Defeating the Unit Door Interlock 67
Open the Door When the Operating Handle Is in the ON/I Position 67
Defeating the Unit Interlock Lever 68
Energize a Unit with the Unit Door Open 69
Locking Provisions 70
Lock Vertical Operating Handles in the OFF/O Position 70
Lock Horizontal Operating Handles in the OFF/O Position 71
Lock Units with Operating Handles in the ON/I Position 71
Unit Interlocks 73

Chapter 7

Final Checklist Before Energizing

Introduction 77
Pre-energizing Check Procedure 77
Perform the Pre-energizing Check Procedure 78
Door Latch Position Diagrams 83
ArcShield Components Checklist 86
SecureConnect Unit Checklist 88
Required Minimum Electrical Spacing 89

Chapter 8

Energizing the Equipment

Energize the Equipment 95

Chapter 9

Maintenance

Maintain the MCC 97
Disconnect Switch and Contact Lubrication 99
Use Thermal Infrared or Other Temperature Measurement Techniques for Preventive Maintenance 101

Inspect the Units for Signs of Overheating. 101

Chapter 10

Maintenance after Fault Condition

Maintain the MCC after a Fault Condition 103

Chapter 11

Renewal Parts

Order Information 105

Chapter 12

Parts Illustrations

Typical Section Construction 107
Typical Construction of a Unit with a Vertical Operating Handle. . . 108
Typical Construction of a Half Space Factor Unit with a Horizontal Operating Handle and Door Mounted Pilot Devices 109
Typical Construction of a Unit with a Horizontal Operating Handle 110

Appendix A

Bulletin 140G Unit Assembly Instructions

Vertical Handle Units 111
- Required Tools. 111
- Install Circuit Breaker 111
- Verify Operation 114
- Adjust Circuit Breaker Position 114

Horizontal Handle and Space Saving Design 115
- Required Tools. 115
- Install Circuit Breaker 115
- Verify Operation 118
- Adjust the Circuit Breaker Position 119

Appendix B

Auxiliary Contact Adapters

Install External Auxiliary Contact Adapter on G, H, and J Frame Horizontal Units. 121
- Required Tools. 121
- Install the Auxiliary Contact Adapter 122

Install External Auxiliary Contact Adapter on G, H, J, and K Frame Units 123
- Required Tools. 123
- Installation 123

Install External Auxiliary Contact Adapter on M and N Frame Units. 125
- Required Tools. 125
- Install the Auxiliary Contact Adapter 125

Notes:

About This Publication

This manual provides detailed installation instructions for installing, using the operator handle, energizing, and maintaining your CENTERLINE® 2100 Motor Control Center.

This manual is intended for engineers or technicians directly involved in the installation, connection, energizing, and maintenance of the CENTERLINE 2100 Motor Control Center.

If you do not have a basic understanding of the CENTERLINE 2100 Motor Control Center, contact your local Allen-Bradley distributor or Rockwell Automation sales representative for information on available training courses.

Additional Resources

The following publications supplement this manual. For more information and further reference, please use these available publications.

Resource	Description
Arc-Flash Resistant Low Voltage Motor Control Center Designs White Paper, publication 2100-AP003	Provides information about arc-resistant motor control centers.
Power Factor Correction Capacitors for Bulletin 2100 MCC Starter Units Application Techniques, publication 2100-AT001	Provides information about the use of power factor correction capacitors.
CENTERLINE 2100 Motor Control Centers Joining and Splicing Vertical Sections Instructions, publication 2100-IN010	Provides information for joining and splicing vertical sections.
CENTERLINE 2100 Motor Control Centers (MCC) Units with Vertical Operating Handles Installation Instructions, publication 2100-IN014	Provides information on installing vertical handle units.
CENTERLINE Motor Control Centers NEMA Type 12 Sealing Instructions, publication 2100-IN037	Provides information on sealing motor control centers to NEMA Type 12 specifications.
Receiving, Handling, and Storing Motor Control Centers Instructions, publication 2100-IN040	Provides information on how to receive, handle, and store motor control centers.
CENTERLINE 2100 MCC Instantaneous Trip Motor Circuit Protectors (MCP) in Combination NEMA Starter, Soft Starter (SMC), and Variable Frequency AC Drive Units Technical Data, publication 2100-TD001	Provides information on using motor circuit protectors in a motor control center.
CENTERLINE 2100 MCC Inverse Time Circuit Breakers in Combination NEMA Starter, Soft Starter (SMC), and Variable Frequency AC Drive Units Technical Data, publication 2100-TD002	Provides information and specifications for circuit breaker use in motor control centers.
CENTERLINE Motor Control Centers Power Fuses Product Data, publication 2100-TD003	Provides information and specifications for fuse use in motor control centers.
DeviceNet Motor Control Centers (MCC) Technical Data, publication 2100-TD019	Provides information for motor control centers using a DeviceNet network.
CENTERLINE Motor Control Centers with EtherNet/IP, publication 2100-TD031	Provides information for motor control centers using an EtherNet/IP network.
CENTERLINE 2100 Motor Control Center End Closing Plates Installation Instructions, publication 2100-IN069	Provides instructions for installing end closing plates.
CENTERLINE 2100 Motor Control Center (MCC) Units with Horizontal Operating Handles Installation Instructions, publication 2100-IN060	Provides information to install units with horizontal operating handles.
CENTERLINE Motor Control Centers Mains and Incoming Lines Dimensions Reference, publication 2100-4.2	Provides dimension drawings for lug compartments, main fusible disconnects, main circuit breakers, and conduit entry.
CENTERLINE Motor Control Centers Installing a Pull Box on a Bulletin 2100 Vertical Section Installation Instructions, publication 2100-5.28	Provides instructions on installing a Pull Box on a motor control center.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control Installation Instructions, publication SGI-1.1	Provides safety guidelines for the application, installation, and maintenance of solid-state control.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documents, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

The documents in the following table are referenced in this document and can be obtained from their respective organizations.

Resource	Website
National Electrical Manufacturer's Association (NEMA) • NEMA ICS 1-2000 Industrial Control and Systems: General Requirements • NEMA ICS 2.3-1995, Instructions for Handling, Operation and Maintenance of Motor Control Centers Rated Not More Than 600V	http://www.nema.org
National Fire Protection Association (NFPA) • NFPA 70 - National Electrical Code • NFPA 70A - Recommended Practice for Electrical Equipment Maintenance • NFPA 70E - Standard for Electrical Safety in the Workplace	http://www.nfpa.org
Institute of Electrical and Electronic Engineers (IEEE) IEEE standard C37.20.7 - IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults	http://www.ieee.org

Purchased Components and Additional Instruction Sheets

When equipment such as transformers, metering, programmable controllers, or drives are supplied with the motor control center (MCC), specific publications are shipped with the units. Read and understand these documents before installing and operating the MCC.

General Information

General Description

Allen-Bradley® CENTERLINE Motor Control Centers (MCCs) consist of one or more vertical sections containing electromagnetic or solid state control devices that are prewired and tested within modular (plug-in) or frame mounted (hard-wired) units.

CENTERLINE MCCs are designed in standard widths of 20 in. (508 mm), 25 in. (635 mm), 30 in. (762 mm), 35 in. (789 mm), and 40 in. (1016 mm). The standard front-mounted depths of an MCC are 15 in. (381 mm) and 20 in. (508 mm), in addition back-to-back mounted depths of 30 in. (762 mm) and 40 in. (1016 mm) are also offered. The standard height of an MCC is 90 in. (2286 mm). A 70.5 in. (1791 mm) high section is also available. All MCC sections are supplied with top and bottom horizontal wireways. Sections that are designed to accommodate plug-in units include a vertical wireway. Each 90 in. (2286 mm) vertical section can accommodate up to 6.0 space factors or 78 in. (1981 mm) for units.

Units (buckets) are designed in increments of 0.5 space factors. Each 0.5 space factor is approximately 6.5 in. (165.1 mm) high. Units are designed as either removable (plug-in) or frame-mounted (non-plug-in).

Individual units house a wide variety of power and logic devices. Plug-in units are mounted on unit support pans within the section. Stab assemblies on the back of the unit plug onto the vertical bus. A mechanical interlock prevents the unit door from being opened when the disconnect is not in the OFF position. An additional mechanical interlock prevents the unit from being plugged-in or unplugged when the disconnect is not in the OFF position.

Line power is distributed throughout the MCC via an isolated bus work structure. The main horizontal bus is in the center of each section. Standard, center-fed, 300 A rated vertical bus supplies power to the individual units above and below the horizontal bus for an effective 600 A capacity, providing virtually unrestricted unit arrangement. An optional 600 A vertical bus provides 1200 A effective rating.

The CENTERLINE MCC is also available with an ArcShield™ rating. The ArcShield rating includes arc-resistant features that are intended to help provide enhanced protection to you during internal arcing faults (when compared to MCCs that are designed only to meet UL 845 requirements). Arcing faults can be caused, for example, by accidental touching, closing into faulted lines, or loose connections. Depending on the application, MCCs with the ArcShield rating can provide up to Type 2 accessibility per IEEE standard C37.20.7, which helps protect you when you are at the front, sides, and rear of the enclosure in the unlikely event of an arcing fault.

A label on the MCC with the ArcShield rating provides information in regard to the accessibility level and arc fault ratings.

For more information about accessibility levels, performance, and testing requirements, refer to IEEE standard C37.20.7, IEEE Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults.

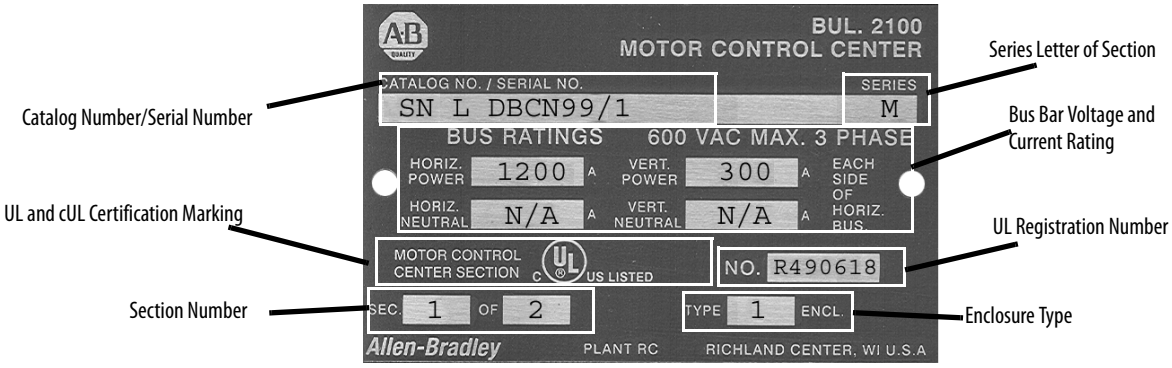
MCCs with the ArcShield rating provide a reinforced structure and arc-containment latches on all doors. To help protect you during an arc-fault, arc-containment latches, when closed and latched properly, provide pressure relief and help keep the doors from unlatching or detaching from the structure.

Nameplate Data

Each MCC section has a nameplate on the enclosure or vertical wireway door. The nameplate includes the following information:

- Catalog number/serial number
- Series letter of section
- Bus bar voltage and current rating
- Section number
- UL and cUL certification marking
- UL registration number
- Enclosure type

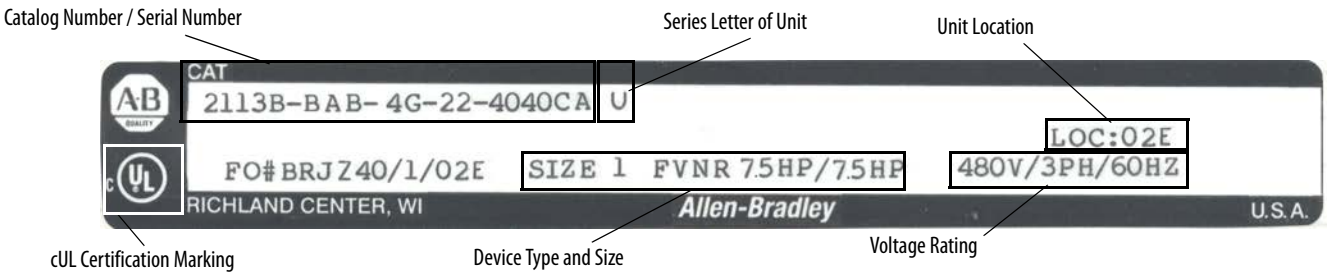
Figure 1 - Section Nameplate



Each plug-in and frame mounted unit also has an identification label. The unit label is on the interior of the bottom plate of plug-in units or on the interior right-hand side plate of the frame mounted units. The unit label for each plug-in or frame mounted unit includes the following information:

- Catalog number/serial number
- Series letter of the unit
- Voltage rating
- Unit location
- UL and cUL certification marking
- Device type and size

Figure 2 - Unit Label



CAT: SERIAL NO: DESCRIPTION: RATING: PLANT: MANUFACTURED ON: ***Allen-Bradley*** **PRODUCT OF:**	WIRING DIAGRAM, # _____ ELEMENT LIST, # _____ IF CENTRALIZED DRAWINGS REQUESTED, DRAWINGS ARE LOCATED BEHIND THE MARKED HORIZONTAL WIREWAY COVER.

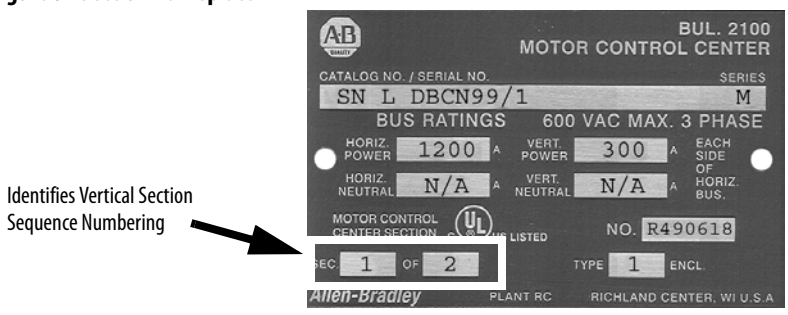
The catalog number or serial number and series letter are required to properly identify the equipment to sales or factory personnel.

MCC Sequence Numbering

CENTERLINE MCCs are designed so functionality is not affected by the section installation order, for example, vertical section-numbering sequence order.

All MCC sections carry a serial plate that identifies vertical section sequence numbering. For example, MCC section 1 of 1, 1 of 5, and so on.

Figure 3 - Section Nameplate



Sections are numbered to match factory-supplied MCC elevation drawings. Numbering each section helps installers and users easily identify MCCs, sections, and units. If there are questions about section numbering during field installation, inspection, or operation, the following information can provide guidance on equipment acceptability, listing, and certification.

CENTERLINE MCC sections can be installed or added as follows:

- In non-sequential order
- Addition of a single section (add-on section)
- Addition of multiple sections (add-on lineup of sections)
- Addition of single section or multiple section between MCC sections

If sections are added to an existing lineup and not installed in sequential order, the installation is not considered a misapplication or in conflict with Underwriter Laboratories (UL) listing and Canadian Standards Association (CSA) certification.

The paramount criteria for additions of sections to existing MCCs is matching the horizontal bus electrical and ingress protection (enclosure type) ratings for the total MCC line up. For example, the voltage, current rating, short circuit withstand, and NEMA enclosure type (IP rating) for all sections must match.

Non-sequential numbering cannot create a functional or listing/certification issue. However, install MCCs sin sequential order. Installing MCCs in sequential order helps ensure proper installation and ensures that factory-supplied documentation matches the equipment.

You can rearrange MCC sections. However, if a section that uses a right-hand side sheet with integral, internal mounting flanges is on the outside of a lineup, an additional closing kit plate is required. Refer to CENTERLINE 2100 Motor Control Center End Closing Plates Installation Instructions, publication 2100-IN069. MCCs that contain arc resistant features cannot use a section with integral mounting flanges on the outside of a lineup.

UL/CSA Marking

CENTERLINE MCCs are listed by Underwriter's Laboratories, Inc. (UL), Standard for Safety UL 845, and certified by the Canadian Standards Associate (CSA), Standard C22-2, No. 14.

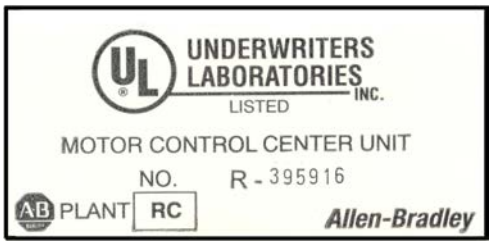
Due to standards harmonization, an MCC can also carry the cUL designation. The cUL designation is comparable to CSA certification.

Vertical sections and units are labeled independently. It is possible to have combinations of labeled and non-labeled sections and units in the same MCC.

Vertical sections and structure options that are UL listed and CSA/cUL certified are marked accordingly. All components in a UL or CSA listed section must be UL listed and cUL/CSA certified. The UL and/or CSA/cUL designation is an integral part of the section nameplate as shown on page 13.

Units and unit options that are UL listed and CSA/cUL certified are marked accordingly. All options and components in a UL and/or cUL/CSA listed unit must be UL listed or recognized and/or cUL/CSA certified. The UL designation is on the interior of the bottom plate of plug-in units or on the interior right-hand side plate of frame mounted units.

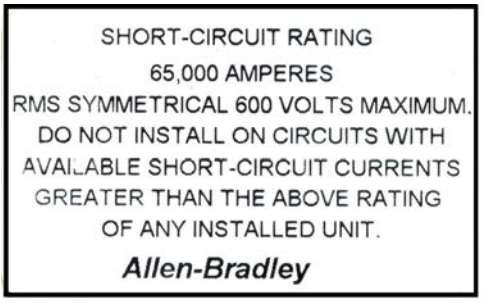
Figure 4 - UL Label Designation for Units



Short-circuit Rating Label

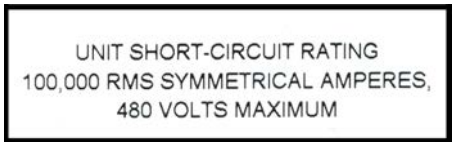
MCC vertical sections that are UL listed and/or CSA/cUL certified carry a short-circuit rating label. The short-circuit rating label for a vertical section is on the inside of the vertical wireway door of standard sections or on the interior right-hand side plate of a section that contains a unit that occupies the full section and does not contain a vertical wireway.

Figure 5 - Short Circuit Label for Sections



MCC units that are UL listed and/or CSA/cUL certified carry a short-circuit rating label on the bottom plate of plug-in units or on interior right-hand side plate of frame mounted units.

Figure 6 - Short Circuit Label for Units

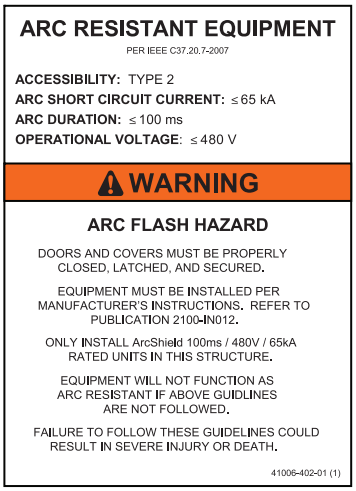


ArcShield Rating Labels

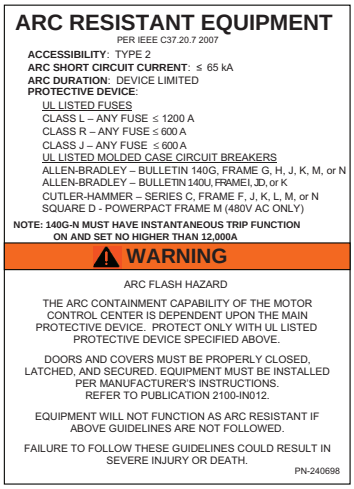
MCC units that have the arc resistant rating carry a rating label on the vertical wireway door. This label serves as the arc resistant nameplate and provides information on the arc resistant rating. There are labels on other parts that need to be in place before operating an arc resistant MCC.

Figure 7 - ArcShield Labels

100 ms Arc Duration


ARC RESISTANT EQUIPMENT
PER IEEE C37.20.7-2007
ACCESSIBILITY: TYPE 2
ARC SHORT CIRCUIT CURRENT: ≤ 65 kA
ARC DURATION: ≤ 100 ms
OPERATIONAL VOLTAGE: ≤ 480 V
WARNING
ARC FLASH HAZARD
DOORS AND COVERS MUST BE PROPERLY CLOSED, LATCHED, AND SECURED.
EQUIPMENT MUST BE INSTALLED PER MANUFACTURER'S INSTRUCTIONS. REFER TO PUBLICATION 2100-IN012.
ONLY INSTALL ArcShield 100ms / 480V / 65kA RATED UNITS IN THIS STRUCTURE.
EQUIPMENT WILL NOT FUNCTION AS ARC RESISTANT IF ABOVE GUIDLINES ARE NOT FOLLOWED.
FAILURE TO FOLLOW THESE GUIDELINES COULD RESULT IN SEVERE INJURY OR DEATH.
41006-402-01 (1)

Device Limited Rating


ARC RESISTANT EQUIPMENT
PER IEEE C37.20.7 2007
ACCESSIBILITY: TYPE 2
ARC SHORT CIRCUIT CURRENT: ≤ 65 kA
ARC DURATION: DEVICE LIMITED
PROTECTIVE DEVICE:
UL LISTED FUSES
CLASS L – ANY FUSE ≤ 1200 A
CLASS R – ANY FUSE ≤ 600 A
CLASS J – ANY FUSE ≤ 600 A
UL LISTED MOLDED CASE CIRCUIT BREAKERS
ALLEN-BRADLEY – BULLETIN 140G, FRAME G, H, J, K, M, or N
ALLEN-BRADLEY – BULLETIN 140U, FRAME I, JD, or K
CUTLER-HAMMER – SERIES C, FRAME F, J, K, L, M, or N
SQUARE D - POWERPACT FRAME M (480V AC ONLY)
NOTE: 140G-N MUST HAVE INSTANTANEOUS TRIP FUNCTION ON AND SET NO HIGHER THAN 12,000A
WARNING
ARC FLASH HAZARD
THE ARC CONTAINMENT CAPABILITY OF THE MOTOR CONTROL CENTER IS DEPENDENT UPON THE MAIN PROTECTIVE DEVICE. PROTECT ONLY WITH UL LISTED PROTECTIVE DEVICE SPECIFIED ABOVE.
DOORS AND COVERS MUST BE PROPERLY CLOSED, LATCHED, AND SECURED. EQUIPMENT MUST BE INSTALLED PER MANUFACTURER'S INSTRUCTIONS. REFER TO PUBLICATION 2100-IN012.
EQUIPMENT WILL NOT FUNCTION AS ARC RESISTANT IF ABOVE GUIDELINES ARE NOT FOLLOWED.
FAILURE TO FOLLOW THESE GUIDELINES COULD RESULT IN SEVERE INJURY OR DEATH.
PN-240698

Series Number and Series ID as Manufactured in the United States

ATTENTION: Read tables 1 through 4 before adding new sections or units to an existing CENTERLINE MCC.

Table 1 - Sections

Series Letter	Scope	Description of Change	Date Implemented in the U.S.
A (1)	—	Original design	February 1971
B (1)	All	Changed terminal blocks	November 1976
C (1)	All	Elimination of external mounting channels	June 1979
D (1)	All	Reverse fed 2192 and 2193	April 1981
E (1)	All	Redesign gasketing	October 1982
F (1)	All	Modified top horizontal wireway pan to accept units with handle interlock in topmost space factor	October 1983
G (1)	42K	42 k bracing-incorporates new bus support and cover	January 1985
G (1)	65K	65 k bracing-incorporates new bus support and cover	July 1985
H	All	New hinge design	January 1986
J	All	Changed handle, operating mechanism, and circuit breaker to Cutler-Hammer series C, 150 A, 250 A, 400 A frame	October 1986
K	All	Changed to new unit grounding system	May 1990
L	All	Changed to new 600…1200 A circuit breaker operating mechanism	February 1996

Table 1 - Sections

Series Letter	Scope	Description of Change	Date Implemented in the U.S.
M	All	Changed to serpentine DeviceNet cabling system	May 2001
N	All	New design for 100,000 A bus bracing and begin use of right-hand sidesheet with integral mounting flanges.	May 2009
P	All	New design for bus covers	February 2012

(1) Replacement and renewal parts are no longer supported. For more information, contact Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

Table 2 - 2100 Units

Series Letter	Scope	Description of Change	Date Implemented in U.S.
A (1)	—	Original design	February 1971
B (1)	All sizes	Changed terminal blocks	November 1976
C (1)	All sizes	Changed handle mechanism to Cutler-Hammer MCPs	June 1979
D(1)	Size 5	Changed from ITE to Allen-Bradley 400A disconnect	April 1981
E (1)	All sizes	Changed from Bulletin 709 series K starters to Bulletin 500 line starters	April 1981
F(1)	All sizes	Redesign of gasketing, wraparound and unit support pan for Bulletin 700 line	October 1982
G(1)	All sizes	Redesign of gasketing, wraparound and unit support pan for Bulletin 500 line	October 1982
H (1)	All sizes	Changed to new door, circuit breaker mechanism and control station	April 1984
J (1)	Size 5	Changed to Bulletin 500 series L	October 1984
	Size 3	Changed to new PCP 100A disconnect	December 1988
	Size 6	Changed to Bulletin 500 series B starters	October 1988
K	Size 1-5 CB units and size 1-2 disc units	Changed handle, operating mechanism and circuit breaker to Cutler-Hammer series C, 150 A, 250 A, 400 A frame	October 1986
L	21A through 54A	Changed to Bulletin 100 line contactors in 21 A, 30 A, 45 A SMC units and original design 24 A, 35 A, 54 A SMC units	November 1989
M	All sizes	Changed to new unit grounding system and 600 A, 800 A, 1200 A bolted pressure switch	May 1990
N	All sizes	Changed to PCP 200 A and 400 A disconnect, derated vacuum Bulletin 2112 and 2113 and new pilot device offerings	January 1993
P	0.5 SF CB units 2103L, 2113, 2193	External auxiliary on circuit breakers	April 1994
Q	All sizes and ratings	New disconnect external auxiliary contacts and new 600 A…1200 A circuit breaker operating mechanism	May 1996
R	SMC units	Redesign and upgrade of ratings for 24 A…500 A SMC-2 and SMC-PLUS units. Original design of SMC Dialog Plus units	August 1997
	1200A 2193	Redesign of 1200A, 2193F and 2193M units	November 1997
	800A 2193	Changed circuit breakers to MDL Frame	November 1998
	225A 2193F	Changed circuit breakers from J Frame to F Frame	October 1999
T	2000A 2193	Changed to flange mounted operating handle	November 2000
	All sizes	Changed the Bulletin 800MR and Bulletin 800T-PS pilot devices to Bulletin 800Es	November 2000
	All 1.5 space factor units	Changed unit bottom plate	November 2000
U	All except 2100-SD1	Changed to new Bulletin 1497 control circuit transformer	July 2001
	2100-SD1	Changed smoke detector head and base components	November 2001

Table 2 - 2100 Units

Series Letter	Scope	Description of Change	Date Implemented in U.S.
V	2162Q, 2163Q, 2164Q, 2165Q	Redesign of 240-480V PowerFlex® 70 and release of 600V PowerFlex 70	April 2002
	2162R, 2163R, 2164R, 2165R	Original release of PowerFlex 700	July 2002
	2154H, 2155H	Original release of SMC™-3	November 2002
	2154J, 2155J	Original release of SMC Flex	April 2004
	2112, size 3, 4 and 5	Redesign to reduced space factor with Class J fuse clip	April 2004
	2162T, 2163T	Original release of PowerFlex 40	September 2004
	2107, 2113, size 3	Reduced space factor	April 2005
X	2162Q, 2163Q	Reduced space factor, changed CCT with integral fuses	April 2005
	All sizes	800F pilot devices	August 2005
Y	2154J, 2155J, 108 A and 135 A	Redesign to change units from frame mounted to plug-in	March 2006
	2164Q, 2164R, 2165Q, 2165R (Drive with manual bypass)	Redesign for change from SMP overload relay to E1Plus overload relay	August 2006
	2107, 2113, size 2 and 3	Redesign due to starter component series letter change	December 2009
Z		Changed to Bulletin 140G and 140MG circuit breakers.	December 2013

(1) Replacement and renewal parts are no longer supported. For more information contact Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

Table 3 - 2400 Units

Series Letter	Scope	Description of Change	Date Implemented in U.S.
A	—	Original design	June 1990
B	18A, 24A, 30A	Changed to series B, Bulletin 194R, 30 A disconnect	March 1992
C	18A, 24A, 30A	Changed to three Bulletin 800E pilot devices on 0.5 space factor units	July 1992
D	All sizes	New disconnect external auxiliary contacts and new 600 A...1200 A circuit breaker operating mechanism	February 1996
	16A-85A	Original design of units with a Bulletin 100-C contactor	September 1999

Series Lettering - Units and Sections

When using sections in conjunction with units of different series letters, consult the table below.

Table 4 - MCC Modifications for Unit and Structure Compatibility

If Mounted in this Type of Section[1],[2]	Plug-in Units		No Additional Parts Required	Requires Style 1 Unit Support Pan	Requires Style 3 Unit Support Pan	Requires Style 3 Unit Support Pan w/ Bushing	Requires Alternate Top Horizontal Wireway Pan	Requires Door Gasketing Kit	Requires Retrofit Kit [3]	Requires Ground Bus Kit
	Space Factor	**Series**	**—**	**2100H-UAJ1**	**2100H-UA12100H-UJ1**	**2100H-USPA1 2100H-USPJ1**	**2100H-NA4A1 2100H-NA4J1 2100H-NA4A2 2100H-NA4J2**	**2100-GJ10**	**2100H-R1 2100H-R2**	**2100H-GS1**
NEMA Type 1 Series A...D [4]	1.0 or larger	A-E [4]	✓	—	—	—	—	—	—	—
		F-L [4]	—	✓	—	—	✓[5]	—	—	—
		M or later [6]	—	✓	—	—	✓[5]	—	—	✓
NEMA Type 1 Series E...J [4]	0.5 [2]	N or later	—	—	—	✓	—	—	✓	✓
	1.0 or larger	A-E [4]	—	—	✓	—	—	—	—	[8]
		F-L [4]	✓	—	—	—	—	—	—	—
		M or later [6]	—	—	—	—	—	—	—	✓
NEMA Type 1 Series K or later	0.5 [2]	N or later	✓	—	—	—	—	—	—	—
	1.0 or larger	A-L [4]	—	—	✓	—	—	—	—	[8]
		M or later	✓	—	—	—	—	—	—	—
NEMA Type 1 w/ gasket or Type 12 Series A...D	1.0 or larger	A-E [4]	✓	—	—	—	—	—	—	—
		F-L [4]	—	✓	—	—	✓ [5]	✓	—	—
		M or later	—	✓	—	—	✓[5]	✓	—	✓

Table 4 - MCC Modifications for Unit and Structure Compatibility

If Mounted in this Type of Section[1],[2]	Plug-in Units		No Additional Parts Required	Requires Style 1 Unit Support Pan	Requires Style 3 Unit Support Pan	Requires Style 3 Unit Support Pan w/ Bushing	Requires Alternate Top Horizontal Wireway Pan	Requires Door Gasketing Kit	Requires Retrofit Kit [3]	Requires Ground Bus Kit
	Space Factor	**Series**	**—**	**2100H-UAJ1**	**2100H-UA12100H-UJ1**	**2100H-USPA1 2100H-USPJ1**	**2100H-NA4A1 2100H-NA4J1 2100H-NA4A2 2100H-NA4J2**	**2100-GJ10**	**2100H-R1 2100H-R2**	**2100H-GS1**
NEMA Type 1 w/ gasket or Type 12 Series E...J [7]	0.5[2]	N or later	—	—	—	✓	—	—	✓	✓
	1.0 or larger	A-E[4]	—	—	✓	—	—	—	—	[8]
		F-L[4]	✓	—	—	—	—	—	—	—
		M or later	—	—	—	—	—	—	—	✓
NEMA Type 1 w/ gasket or Type 12 Series K or later	0.5[2]	N or later	✓	—	—	—	—	—	—	—
	1.0 or larger	A-L[4]	—	—	✓	—	—	—	—	[8]
		M or later	✓	—	—	—	—	—	—	—

(1) When installing unit in topmost location in vertical sections, care must be taken to comply with the National Electric Code 6.7 ft (2000 mm) unit handle-to-floor height limitation. A unit operating handle extender (catalog number 2100-NE1) that provides 3 in. (76.2 mm) added height flexibility is available.

(2) When CENTERLINE 2100, 0.5 space factor or Space Saving NEMA Starter plug-in units are ordered unassembled or ordered for existing sections, order a centralized wiring diagram holder kit (catalog number 2100H-WDH).

(3) Permits installation of 0.5 space factor or Space Saving NEMA Starter plug-in units in existing series E...J CENTERLINE 2100 vertical sections.

(4) Replacement and renewal parts are no longer supported. Contact Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

(5) Required only if series F or later, 1.0 space factor or larger CENTERLINE 2100 unit is installed in topmost location of series A...E vertical sections.

(6) For more information regarding possible door hinge requirements, contact Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

(7) Series E...J sections cannot accommodate 0.5 space factor or Space Saving NEMA Starter plug-in units in bottom-most unit location.

(8) A ground strap can be used to ground units rather than installing a ground bus. Refer to the CENTERLINE 2100 Motor Control Centers (MCC) Units with Vertical Operating Handles Installation Instructions, publication 2100-IN014.

Receiving, Handling, and Storage

Refer to the following sections for information on receiving, handling, and storage of MCC units.

Receiving

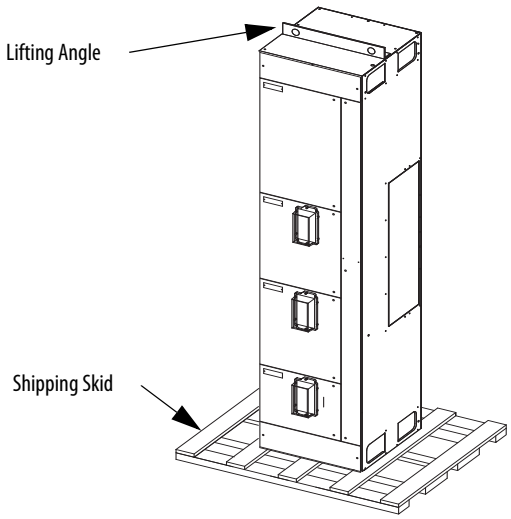
As standard, CENTERLINE MCCs are shipped upright in shipping blocks of one to three front-mounted sections or two to six back-to-back sections. Each shipping block of an MCC is provided with a lifting angle. The lifting angle is optional on NEMA Type 3R and Type 4 MCCs. Each vertical section in a shipping block is bolted to the shipping skid and covered with clear plastic wrap. Equipment that extends from the structures is also protected. Protection is for upright shipping and is not waterproof or watertight. If necessary, other types of packaging are available.

Refer to publication 2100-IN040 for receiving, handling, and storage instructions. This publication is shipped with each MCC, attached to the outside of the MCC within the layer of clear plastic wrap. For additional information about the handling, installation, operation, and maintenance of MCCs rated more than 600V, consult NEMA ICS 2.3-1995.

Export Packaging

A maximum of three vertical sections standing upright can be shipped with export packaging together in one block. The MCC is bolted to a skid and wrapped in poly wrap suitable for occasional water-spray; a wooden frame and chipboard surround the sections. Export packaging is not watertight, waterproof, or intended for long-term storage. Extended storage can require space heaters and other considerations. Export packing adds extra weight and dimensions to the shipping block.

Figure 8 - Handling and Receiving MCCs



Handling

Lifting with a forklift, overhead lifting, sling lifting, and pipe or rod rolling are methods that can be used to handle vertical sections. See the following tables for typical weights and dimensions for standard 20 in. (508 mm) wide and 15 in. (381 mm) or 20 in. (508 mm) deep sections. For sizes not listed, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Table 5 - Shipping Weights and Dimensions - Standard Packaging

Standard Packing (1)	Weight lb (kg), approx.	Height in. (cm), approx.	Depth in. (cm), approx.	Width in. (cm), approx.
Front mounted 1-section block	500 (227)	96 (244)	36 (91)	43 (109)
Front mounted 2-section block	1000 (454)	96 (244)	36 (91)	43 (109)
Front mounted 3-section block	1500 (680)	96 (244)	36 (91)	63 (160)
Back-to-back 2-section block	1000 (454)	96 (244)	42 (107)	43 (109)
Back-to-back 4-section block	1800 (816)	96 (244)	42 (107)	43 (109)
Back-to-back 6-section block	2200 (998)	96 (244)	42 (107)	63 (160)

(1) Standard packing for shipments in the United States and Canada. The MCC shipping block is mounted on a skid and covered in clear plastic wrap. This packaging is not watertight or waterproof.

Table 6 - Shipping Weights and Dimensions - Export Packaging

Export Packing (below deck)(1)	Weight lb (kg), approx.	Height in. (cm), approx.	Depth in. (cm), approx.	Width in. (cm), approx.
Front mounted 1-section block	600 (295)	99 (252)	37 (94)	44 (112)
Front mounted 2-section block	1150 (522)	99 (252)	37 (94)	44 (112)
Front mounted 3-section block	1650 (748)	99 (252)	37 (94)	64 (163)
Back-to-back 2-section block	1200 (544)	99 (252)	43 (109)	44 (112)
Back-to-back 4-section block	2000 (907)	99 (252)	43 (109)	44 (112)
Back-to-back 6-section block	2450 (1111)	99 (252)	43 (109)	64 (163)

(1) Export packing for below deck is required for all international shipments. The MCC shipping block is mounted on a skid and covered in clear plastic wrap. This packaging is not watertight or waterproof. Additional packing materials surround the shipping block. The export packing adds extra weight and increases the dimension of the shipping block.

ATTENTION: MCCs are top and front heavy. To avoid personal injury or structural damage, never attempt to lift or move the MCC by any means other than the methods outlined in Receiving, Handling, and Storing Motor Control Centers, publication 2100-IN040.

Storage and Operation

CENTERLINE MCCs conform to NEMA standard ICS 1-2000 for service and storage conditions. MCC ambient operating temperature range is 0...40 °C (32...104 °F) at 95% noncondensing humidity. Ambient storage temperature range is -30...65 °C (-22...149 °F). In addition, MCCs have an altitude class of 2 km (1 km for MCCs that contain variable frequency drives). The altitude class of 2 km designates equipment for installation where the altitude does not exceed 2000 m (6600 ft). For installation above 2000 m (6600 ft), contact Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

Notes:

Installation Procedures

Location Planning

When planning the location for your CENTERLINE MCC, consider the following:

- Conduits
- Busways
- Overall height of installation area
- Alignment with other equipment
- Future needs
- Ambient temperature

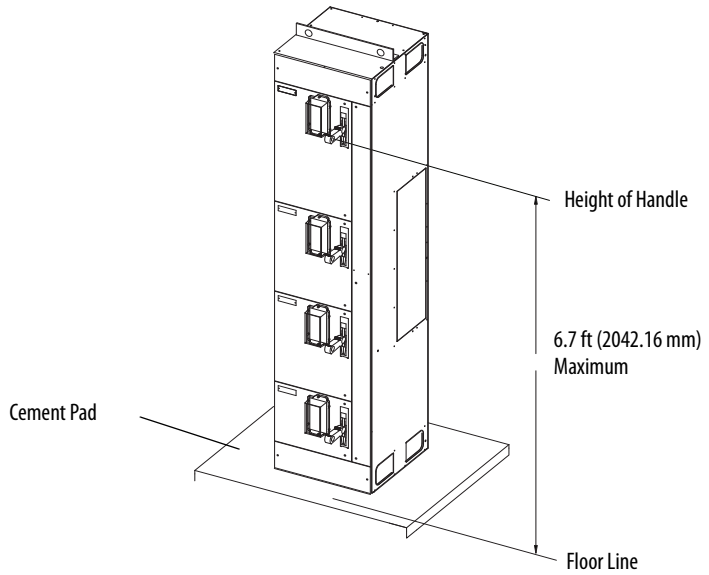
The area must be level and the environment must be compatible with the NEMA enclosure rating of the equipment

Documentation packages shipped with assembled MCCs include an MCC elevation drawing and an MCC floor plan layout.

Height Considerations

If the MCC is equipped with optional external mounting channels or is mounted on a pad, the height from the floor to the center of the top handles must be checked for compliance with NFPA 70 National Electrical Code (NEC) Article 404.8 and UL Standard 845. If the distance from the floor to the center of the highest handle is greater than 6.7 ft (2042.16 mm), add a unit operating handle extender (catalog number 2100H-NE1).

Figure 9 - Height Planning Dimensions



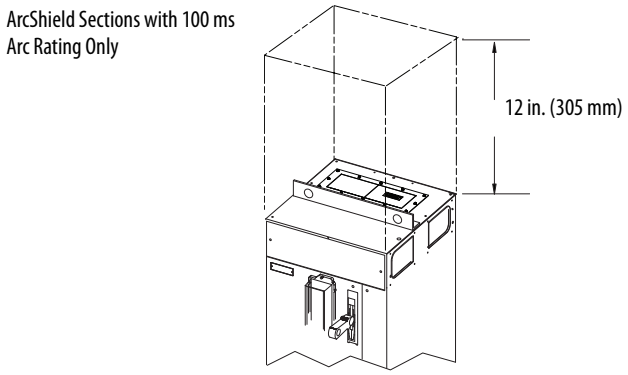
ArcShield Clearance Height

The area above the MCC top plate must be unrestricted for the proper operation of the pressure relief venting system.

- A minimum clearance above the top of the MCC of 12 in. (305 mm) must be available for pressure relief and/or venting if an internal arcing fault occurs.
- Conduit, cable, and wiring must be installed in such a way so that it does not interfere with the opening of the top plate vent (no cable or conduit in the top-rear of cabinet; cable trays must be a minimum of 12 in. (305 mm) above the top plate).

IMPORTANT Do not remove the lifting angle from ArcShield sections with 100 ms arc resistant rating.

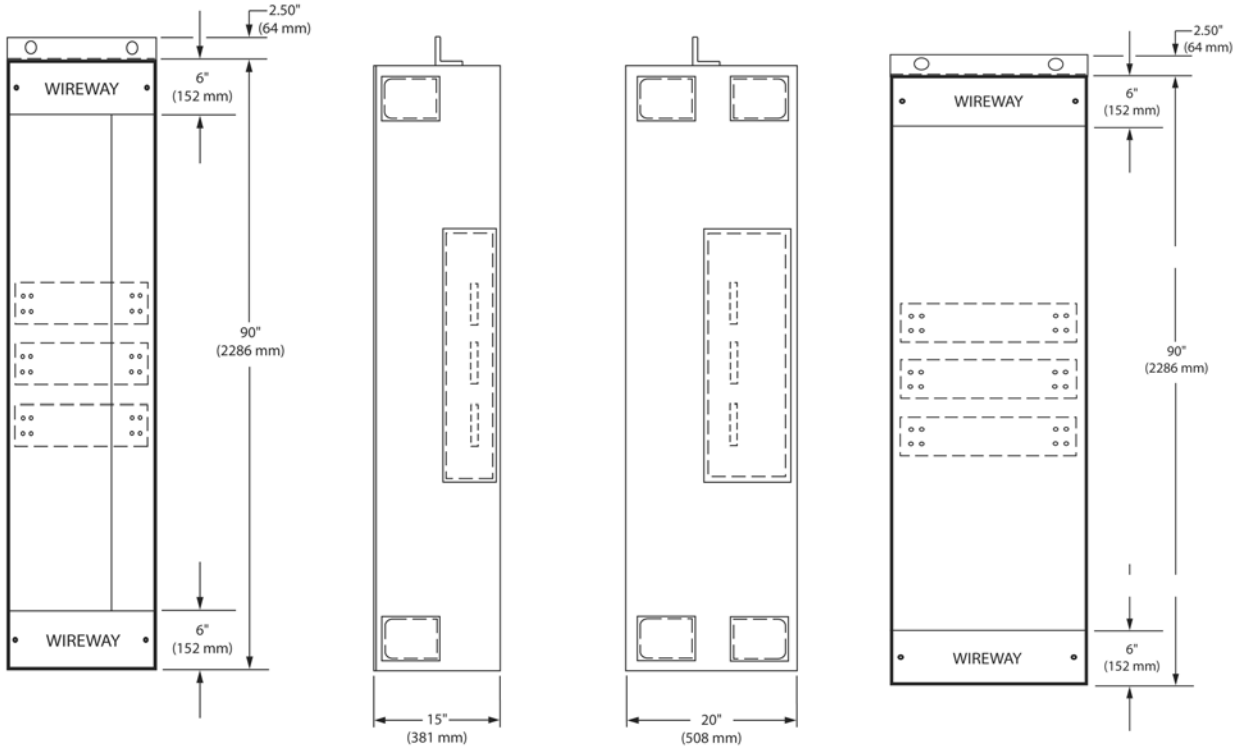
Figure 10 - ArcShield Planning Dimensions



Securing an MCC

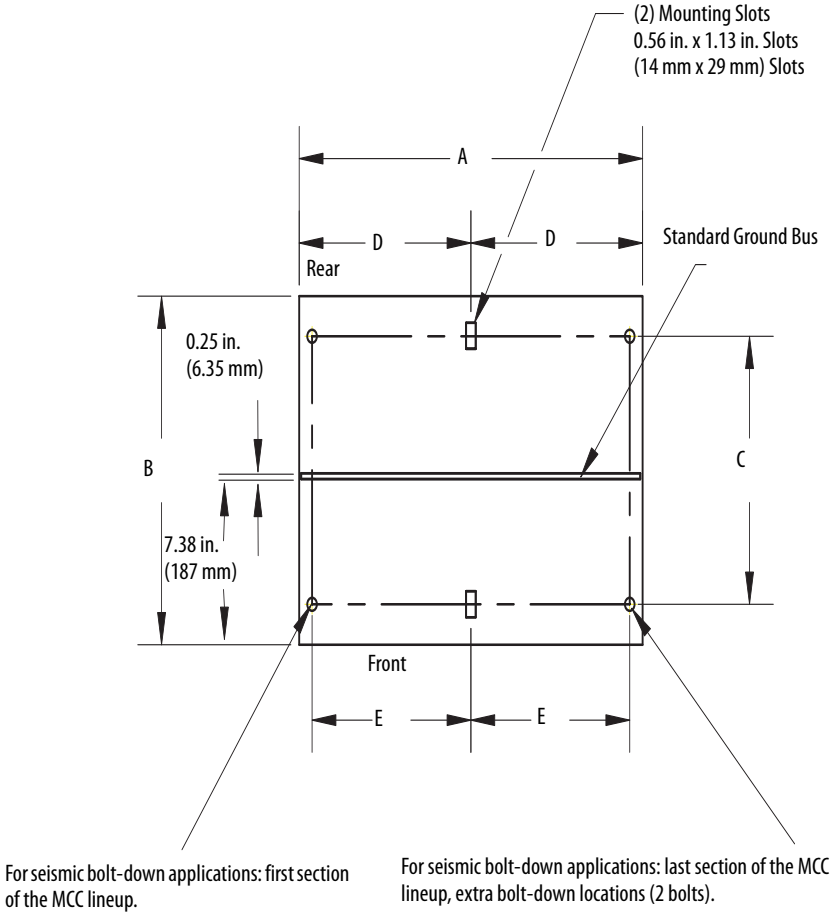
Anchor bolts [1/2 in. (13 mm)] can be embedded in the foundation prior to installation. Two bolts per vertical section fasten the MCC through its internal mounting angle to the foundation [corner sections require three bolts and 40 in. (1016 mm) wide sections require four bolts]. See the following illustrations and tables for general dimensions. Dimensions matching your equipment can be found on the elevation drawings shipped with your MCC.

Figure 11 - Mounting Dimensions for 15 in. and 20 in. Sections



IMPORTANT The external vertical support angle on MCC sections with 100 ms arc-resistant rating add an additional 2 in. (50.8 mm) to each end of the lineup.

Figure 12 - Mounting Dimensions for 15 in. and 20 in. Sections - continued

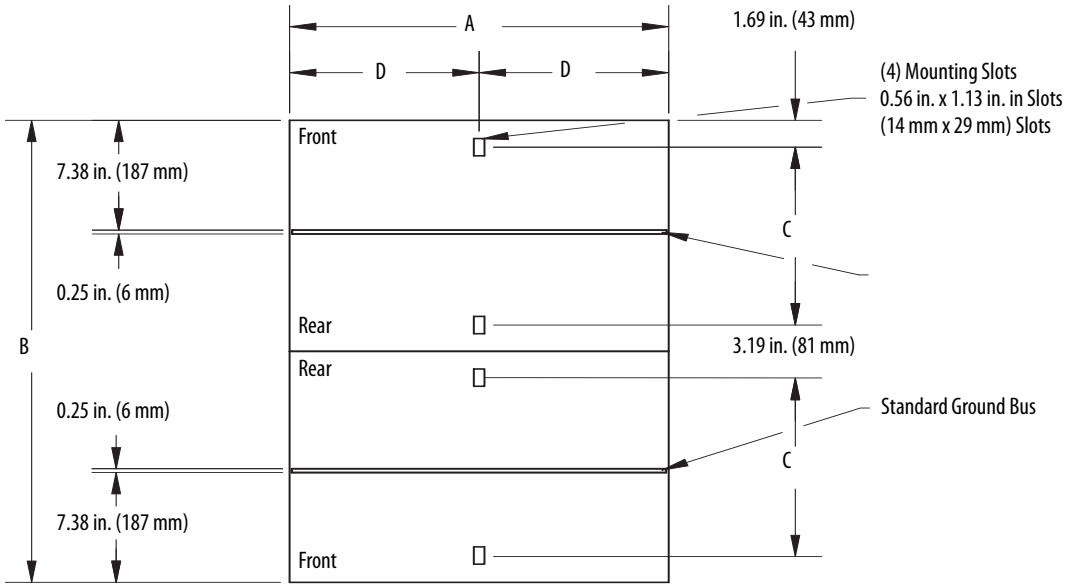


The optional external mounting channels add 1.5 in. (38.1 mm) to the height.

Dimensions approx.	15 in. Deep				20 in. Deep			
	20 in. Wide in. (mm)	25 in. Wide in. (mm)	30 in. Wide in. (mm)	35 in. Wide in. (mm)	20 in. Wide in. (mm)	25 in. Wide in. (mm)	30 in. Wide in. (mm)	35 in. Wide in. (mm)
A	20.00 (508)	25.00 (635)	30.00 (762)	35.00 (889)	20.00 (508)	25.00 (635)	30.00 (762)	35.00 (889)
B	15.00 (381)	15.00 (381)	15.00 (381)	15.00 (381)	20.00 (508)	20.00 (508)	20.00 (508)	20.00 (508)
C	11.56 (294)	11.56 (294)	11.56 (294)	11.56 (294)	16.56 (421)	16.56 (421)	16.56 (421)	16.56 (421)
D	10.00 (254)	12.50 (318)	15.00 (381)	17.50 (445)	10.00 (254)	12.50 (318)	15.00 (381)	17.50 (445)
E(1)	9.25 (235)	11.75 (299)	14.25 (362)	16.75 (426)	9.25 (235)	11.75 (299)	14.25 (362)	16.75 (426)

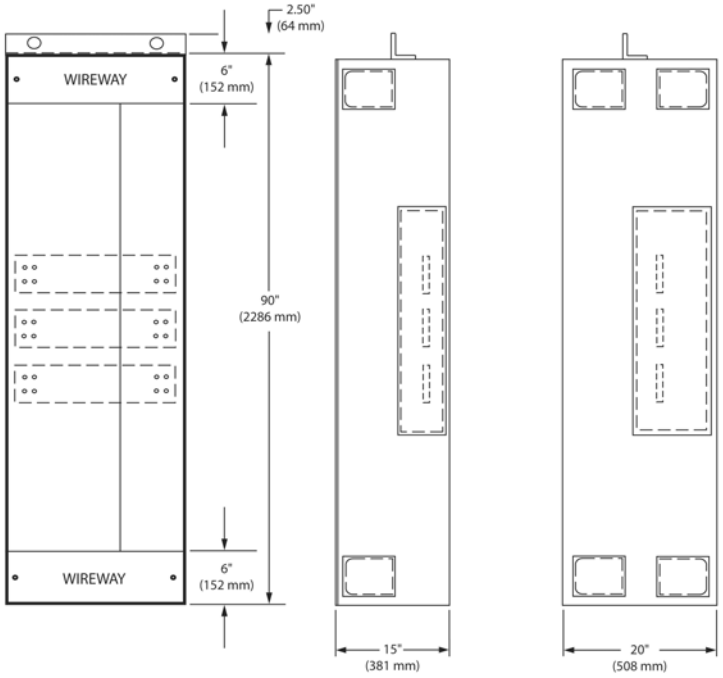
(1) Applies to first and last sections that require seismic ratings.

Figure 13 - Mounting Dimensions for 30 in. and 40 in. Deep Back-to-Back Section



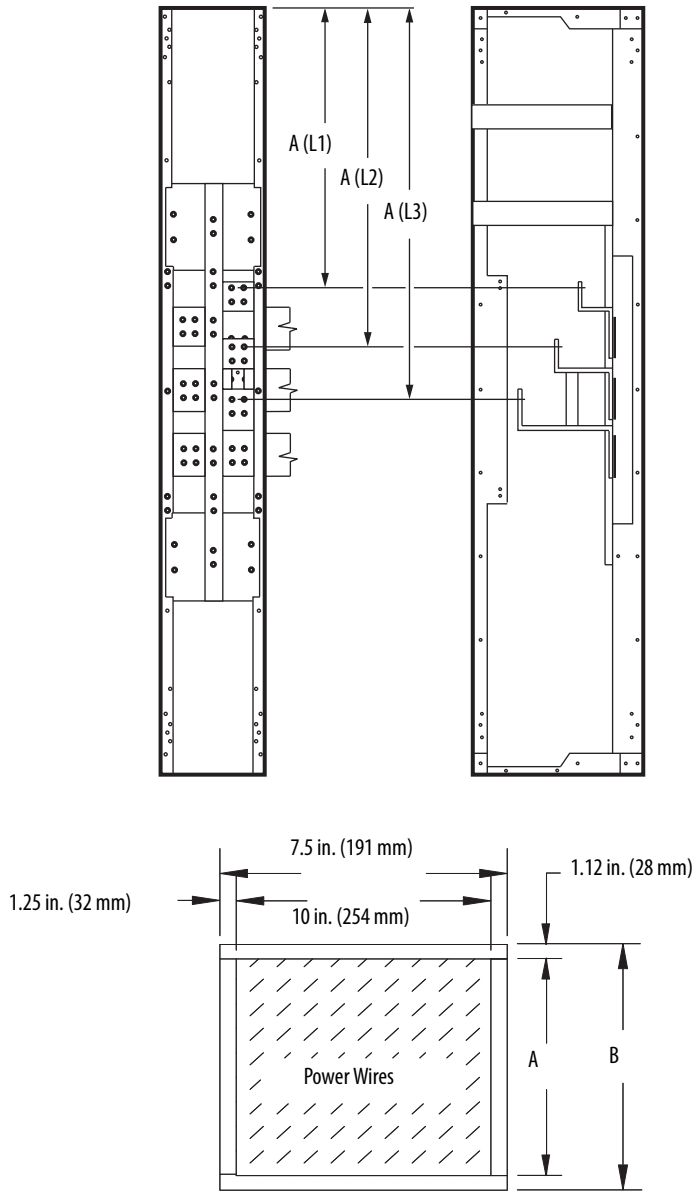
Dimensions approx.	20 in. Deep				40 in. Deep			
	20 in. Wide in. (mm)	25 in. Wide in. (mm)	30 in. Wide in. (mm)	35 in. Wide in. (mm)	20 in. Wide in. (mm)	25 in. Wide in. (mm)	30 in. Wide in. (mm)	35 in. Wide in. (mm)
A	20.00 (508)	25.00 (635)	30.00 (762)	35.00 (889)	20.00 (508)	25.00 (635)	30.00 (762)	35.00 (889)
B	30.00 (762)	30.00 (762)	30.00 (762)	30.00 (762)	40.00 (1016)	40.00 (1016)	40.00 (1016)	40.00 (1016)
C	11.56 (294)	11.56 (294)	11.56 (294)	11.56 (294)	16.56 (421)	16.56 (421)	16.56 (421)	16.56 (421)
D	10.00 (254)	12.50 (318)	15.00 (381)	17.50 (445)	10.00 (254)	12.50 (318)	15.00 (381)	17.50 (445)

Figure 14 - Mounting Dimensions for 25 in. Wide Section with 9 in. (228.6 mm) Wireway [90 in. (2286 mm) high]



The optional external mounting channels add 1.5 in. (38.1 mm) to the height.

Figure 15 - Mounting Dimensions for 10 in. Wide Section with 10 in. (254 mm) Incoming Line Section



Dimension, approx.	Section Depth	
	15 in. (381 mm) Deep in. (mm)	20 in. (508 mm) Deep in. (mm)
A	12.75 (324)	17.75 (451)
B	14.75 (375)	19.75 (502)

Figure 16 - Mounting Dimensions for NEMA 3R and 4 Section [90 in. (2866 mm) high]

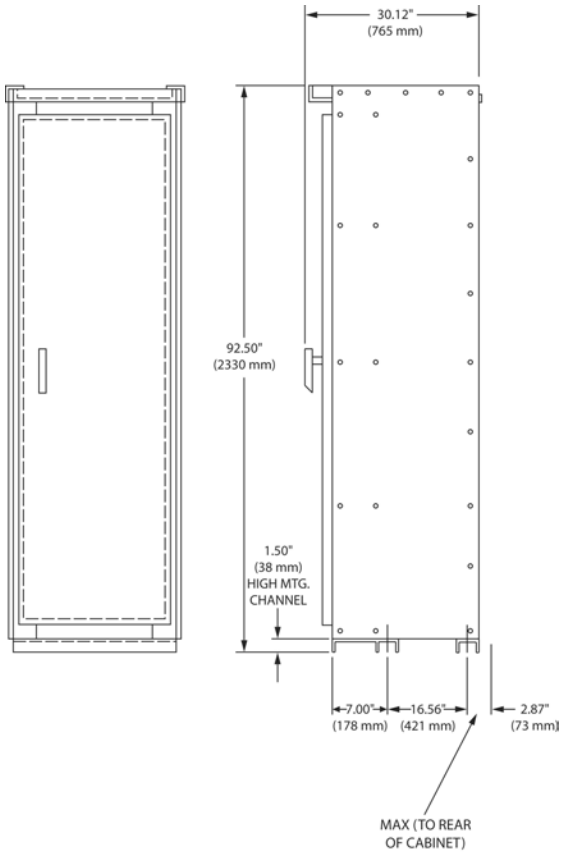
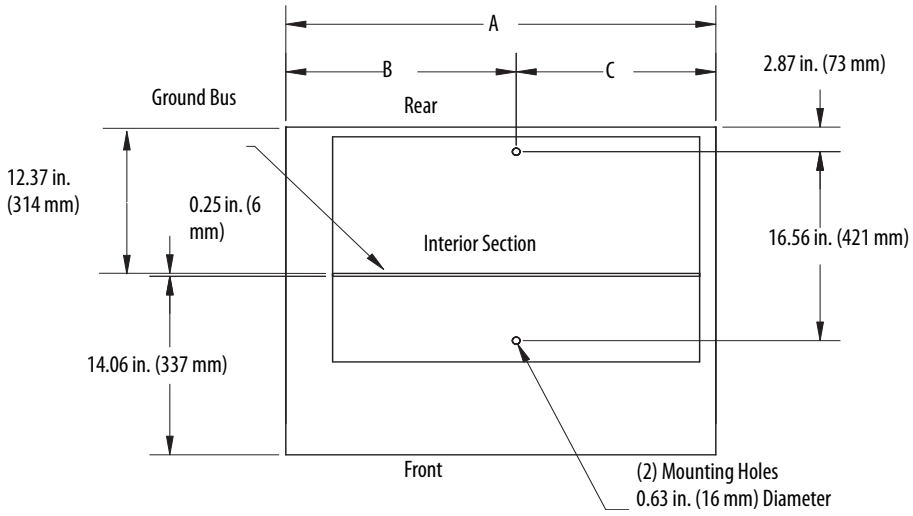


Figure 17 - Mounting Dimensions for NEMA 3R and 4 Section

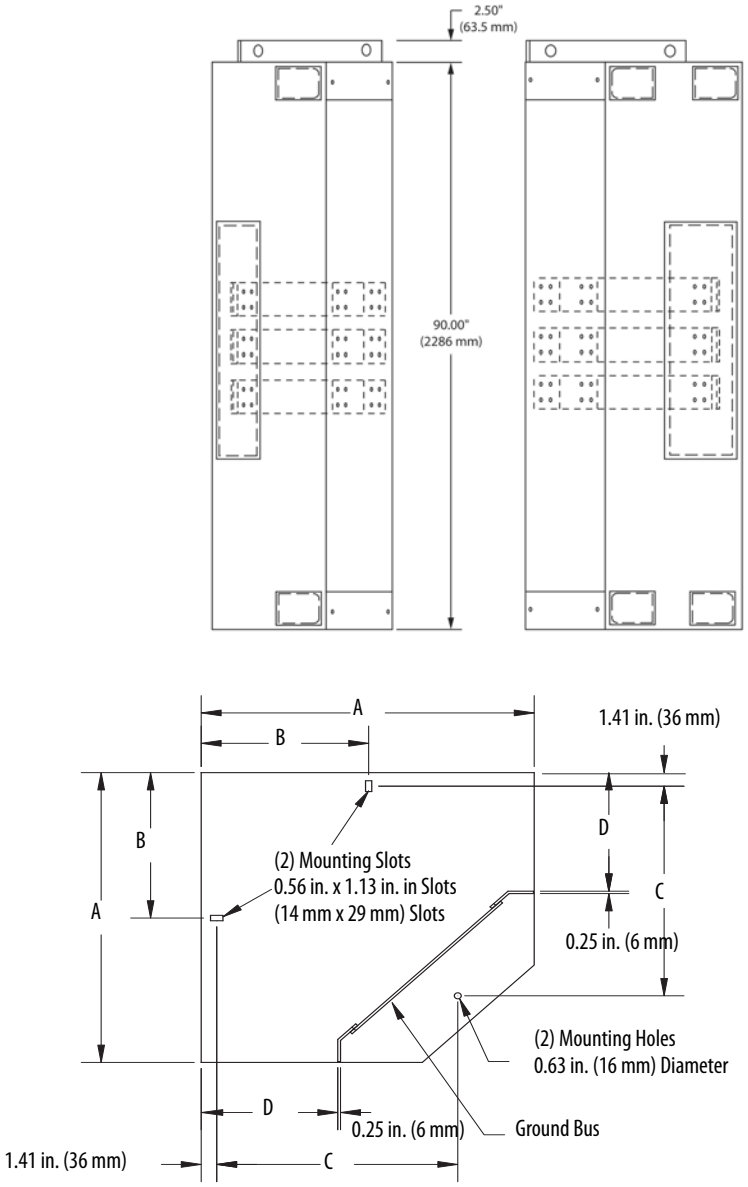


If the optional non-removal lifting angle is supplied, add 3.63 in. (92.2 mm) to height.

Dimension, approx.	Exterior Section Width		
	20 in. (508 mm) Wide(1) in. (mm)	25 in. (635 mm) Wide(1) in. (mm)	30 in. (762 mm) Wide(1) in. (mm)
A	25.00 (635)	30.00 (762)	35.00 (889)
B	13.75 (349)	16.25 (413)	18.75 (476)
C	11.25 (286)	13.75 (349)	16.25 (413)

(1) This measurement is the interior section width.

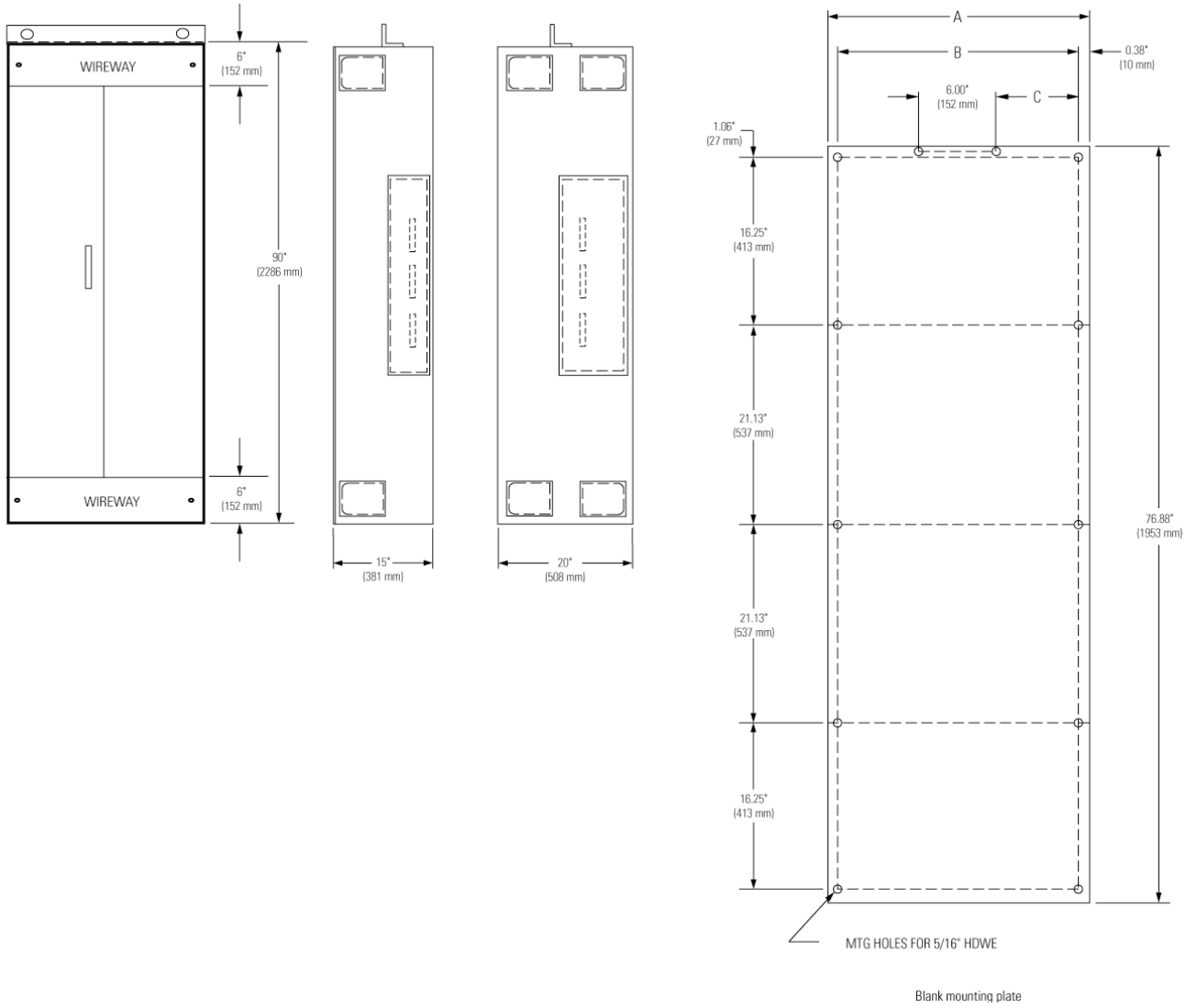
Figure 18 - Mounting Dimensions for 15 in. and 20 in. Deep Corner Section [90 in. (2866 mm) high]



The optional external mounting channels add 1.5 in. (38.1 mm) to the height.

Dimension, approx.	Section Depth	
	15 in. (381 mm) Deep in. (mm)	20 in.(635 mm) Deep in. (mm)
A	25.13 (638)	30.13 (765)
B	12.63 (321)	15.13 (384)
C	16.81 (427)	21.81 (554)
D	17.62 (448)	22.62 (575)

Figure 19 - Mounting Dimensions for 15 in. and 20 in. Deep x 40 in. Wide Front-mounted Section

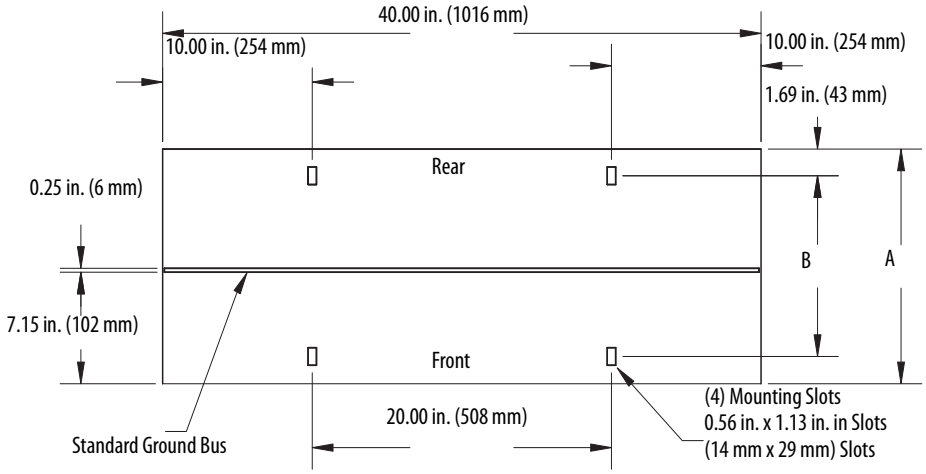


The optional external mounting channels add 1.5 in. (38.1 mm) to the height.

Dimensions approx.	Section Width[1]				
	20 in. Wide in. (mm)	25 in. Wide in. (mm)	30 in. Wide in. (mm)	35 in. Wide in. (mm)	40 in. Wide in. (mm)
A	17.25 (438)	22.25 (565)	27.25 (692)	32.25 (819)	37.25 (946)
B	16.50 (419)	21.50 (546)	26.50 (673)	31.50 (800)	36.50 (927)
C	5.25 (133)	7.75 (197)	10.25 (260)	12.75 (324)	15.25 (387)

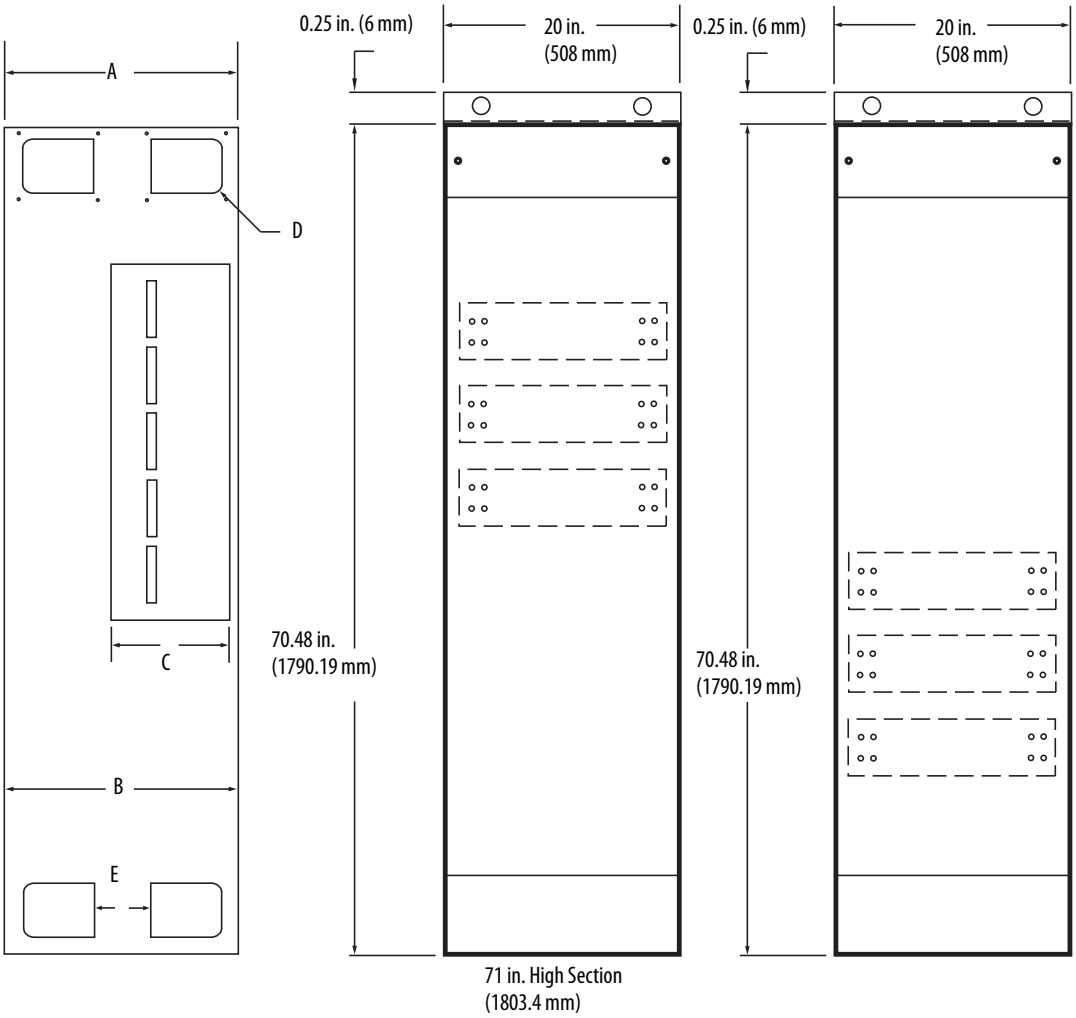
(1) When a horizontal bus or a disconnecting means (switch or circuit breaker) is specified, reduce the 'A' dimension by 5 in. (127 mm).

Figure 20 - Mounting Dimensions for 15 in. and 20 in. Deep x 40 in. Wide Front-mounted Section



Dimension, approx.	Section Depth	
	15 in. (381 mm) Deep in. (mm)	20 in. (508 mm) Deep in. (mm)
A	15 (381)	20 (508)
B	11.56 (294)	16.56 (421)

Figure 21 - Mounting Dimensions for 71 in. H (reduced height) MCC Sections



Dimension, approx.	Section Depth	
	15 in. (381 mm) Deep in. (mm)	20 in.(635 mm) Deep in. (mm)
A	15.00 (380)	20.00 (508)
B	14.75 (374)	19.75 (500)
C	5.12 (130)	10.12 (256)
D	4 (101)	8 (203)
E	—	4.40 (112)

Seismic Requirements

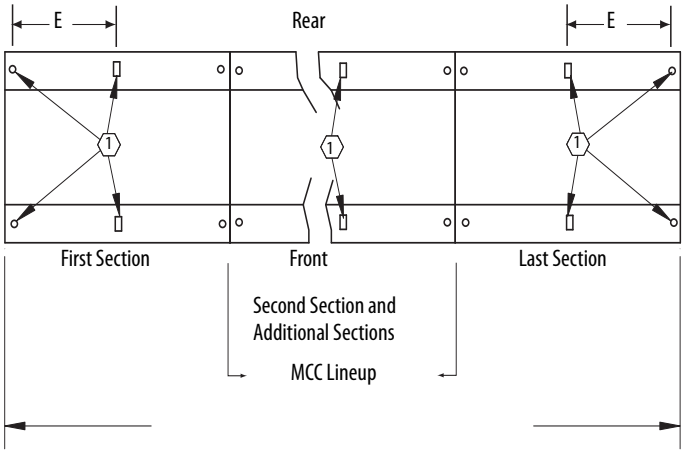
To demonstrate the seismic withstand of various CENTERLINE MCCs [20 in. deep (508 mm), 30 in. deep (762 mm) back-to-back, and 40 in. deep (1016 mm) back-to-back], the MCC design construction has been qualified by seismic calculations per the Uniform Building Code (UBC). CENTERLINE 2100 MCC samples have been seismically qualified by dynamic (triaxial multi-frequency testing) seismic tests per IEEE 344 Seismic Test Standards. The results of the MCC seismic testing demonstrated compliance with the 100% g level of Uniform Building Code 1997 (UBC) zone 4 (the maximum UBC zone) and 100% g level of The International Building Code 2006 (IBC), for example, the MCC structure, the MCC units, and the MCC components or electrical functions were not compromised when subjected to a UBC Zone 4 earthquake, or the IBC seismic event. Per the IEEE 344 standard, the equipment was under power and operated before, during, and after the seismic tests.

IMPORTANT Variable frequency drive units using 'rollout' drive configurations are not seismically tested.

To obtain a UBC or IBC seismic withstandability, each individual CENTERLINE 2100 MCC lineup (for example, both front and back MCCs in 'back-to-back applications), must be mounted on an adequate seismic foundation and installed per the seismic anchoring requirements as shown in the following illustrations.

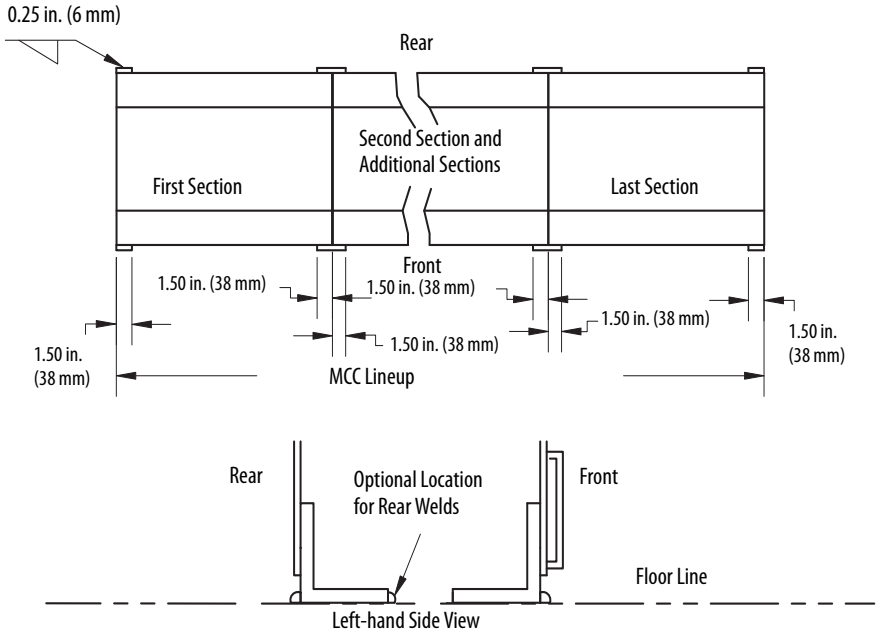
In seismic application dimensions 'E' applies to the first and last sections of the MCC lineup. See Figure 11 -Mounting Dimensions for 15 in. and 20 in. Sections for dimensions.

Figure 22 - Seismic Bolt Down Requirements



[1]The hardware required is 1/2 in.-13 Grade 5 or HSL-3 M12 or better bolts embedded in the foundation.

Figure 23 - Seismic Weld Down Requirements



Joining and Splicing New MCCs

A main horizontal bus splice kit must be installed between shipping blocks of new MCCs to connect the main horizontal bus. In addition, the neutral bus splice kit (if required) and the ground bus splice kit must be installed between shipping blocks. Refer to CENTERLINE 2100 Motor Control Centers Joining and Splicing Vertical Sections Instructions, publication 2100-IN010.

Joining and Splicing Existing MCCs

A main horizontal bus, a neutral bus (if required), and a ground bus splice kit must be installed when adding to existing CENTERLINE MCCs. When adding to existing MCCs, you must identify the series of the MCC that you are adding to. If the existing MCC is series A or B, you must consult MCC technical support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support for joining and splicing procedures. When the existing MCC is series C or later, refer to CENTERLINE 2100 Motor Control Centers Joining and Splicing Vertical Sections Instructions, publication 2100-IN010.

Be sure to also connect network cables and other control cables as required.

Joining and Splicing MCCs with ArcShield

In addition to the horizontal, neutral (if required), and ground bus splicing kits, CENTERLINE MCCs with arc-resistant ratings have these additional requirements:

- MCCs with the 100 ms arc-resistant rating have a back-corner baffle at the end of each lineup and insulation on the side closing-plate at the end of the lineup. They also have external vertical support angles at each end of the lineup.
- MCCs with the device-limited rating have insulation on the horizontal bus side closing-plates at each end of the lineup.

Installing and Joining Pull Boxes

When pull boxes are supplied with your MCC, refer to Installing a Pull Box on a Bulletin 2100 Vertical Section, publication 2100-IN029, for installing and joining the pull box onto the vertical section.

Joining and Splicing NEMA Type 12 MCCs

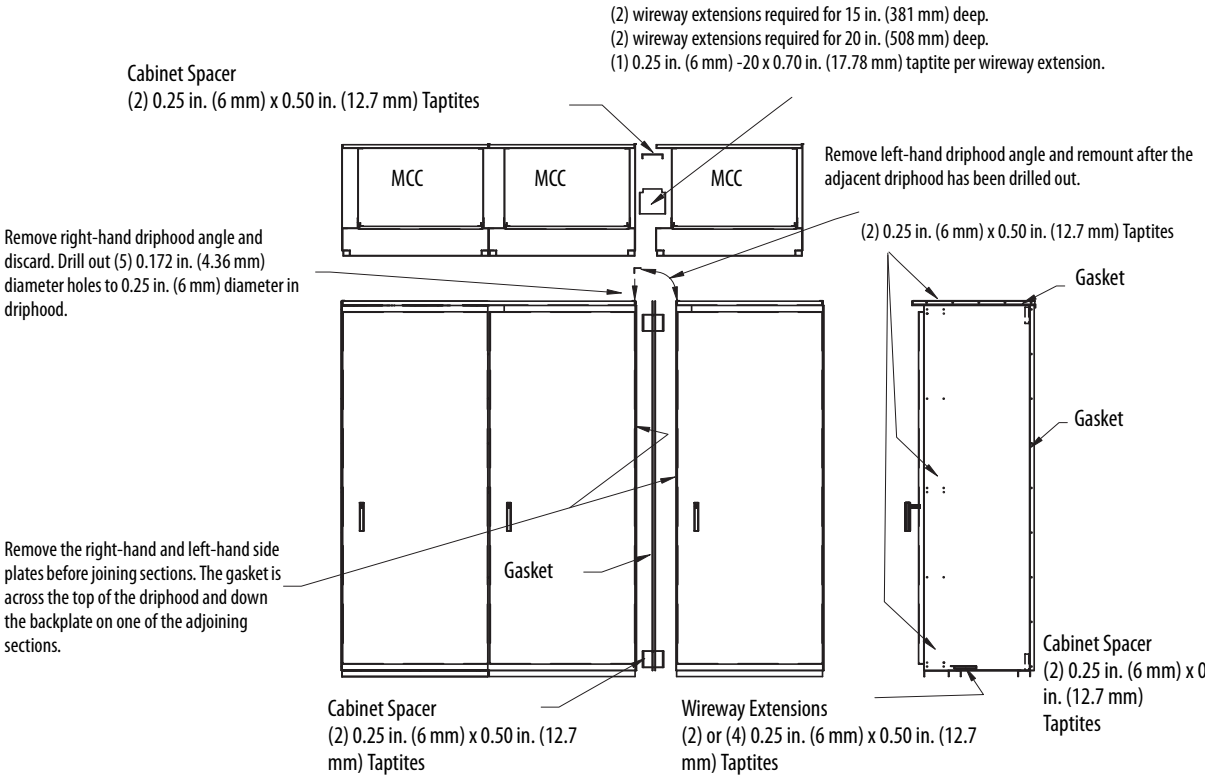
NEMA Type 12 MCCs must be properly installed to prevent the ingress of dust and dirt. Follow the caulking instructions in the NEMA Type 12 Sealing Instructions, publication 2100-IN037, supplied with the NEMA 12 MCC. Use caulk to close any mounting holes in the bottom plates and bolt holes between shipping splits.

It is necessary that all door latches and wireway doors be fully latched to prevent dust and dirt from entering the enclosure and to meet NEMA Type 12 requirements.

Joining and Splicing NEMA Type 3R and Type 4 MCCs

A main horizontal bus, a neutral bus (if required) and a ground bus splice kit must be installed between the internal sections for new and existing NEMA Type 3R and Type 4 MCCs. Refer to CENTERLINE 2100 Motor Control Centers Joining and Splicing Vertical Sections Instructions, publication 2100-IN010, for splicing Type 3R and Type 4 internal sections.

Figure 24 - Joining Instructions for NEMA Type 3R and 4 Sections


(2) wireway extensions required for 15 in. (381 mm) deep.
(2) wireway extensions required for 20 in. (508 mm) deep.
(1) 0.25 in. (6 mm) -20 x 0.70 in. (17.78 mm) taptite per wireway extension.
Cabinet Spacer
(2) 0.25 in. (6 mm) x 0.50 in. (12.7 mm) Taptites
MCC
MCC
MCC
Remove left-hand driphood angle and remount after the adjacent driphood has been drilled out.
(2) 0.25 in. (6 mm) x 0.50 in. (12.7 mm) Taptites
Remove right-hand driphood angle and discard. Drill out (5) 0.172 in. (4.36 mm) diameter holes to 0.25 in. (6 mm) diameter in driphood.
Gasket
Gasket
Remove the right-hand and left-hand side plates before joining sections. The gasket is across the top of the driphood and down the backplate on one of the adjoining sections.
Gasket
Cabinet Spacer
(2) 0.25 in. (6 mm) x 0
in. (12.7 mm)
Taptites
Cabinet Spacer
(2) 0.25 in. (6 mm) x 0.50 in. (12.7 mm) Taptites
Wireway Extensions
(2) or (4) 0.25 in. (6 mm) x 0.50 in. (12.7 mm) Taptites

Bus Torque Specifications

Tighten all bus splice connections with a torque wrench and socket at intervals established by your maintenance policy. See Chapter 9 for suggested maintenance. If a torque wrench is not available, tighten until the conical spring washer is flat.

Torque values can be found on the information label on the interior of the vertical wireway door or on the interior right-hand side plate of frame mounted units.

Installing Conduit and Cable

Installing Conduit

When installing conduit, make sure it is installed according to local codes - to assure water and moisture cannot enter or accumulate in the MCC enclosure. Conduit must be installed so they are compatible with the NEMA rating of the MCC. Place the conduit away from the horizontal ground bus to avoid damage. We recommend that the conduit be positioned to minimize cable bending and maintain relative vertical alignment to incoming connections.

Bottom Entry Conduit

Follow this procedure if your conduit is entering from the bottom.

1. Prepare the installation site so the foundation is level.
2. Before the MCC is installed, place and stub up conduit approximately 2 in. (51 mm) above floor level, making sure all incoming conduit is clear of the horizontal ground bus.

   For approximate section base dimensions and ground bus locations, refer to Installation Procedures, Chapter 2, or elevation and floor plan drawings shipped with MCC.

   For approximate bottom entry locations and wiring schemes for main fusible disconnects, main circuit breakers, and incoming line compartments, refer to Mains and Incoming Lines Dimension Reference, publication 2100-TD018.

Top Entry Conduit

ATTENTION: For ArcShield units with 100 ms arc duration rating, conduit, cable, and wiring must be installed in such a way so that it does not interfere with the opening of the top plate vent (no cable or conduit in the top-rear of cabinet; cable trays must be a minimum of 12 in. (305 mm) above the top plate).

Follow this procedure if your conduit is entering from the top.

1. After the MCC is in place, leveled, and the sections are joined and spliced, bring conduit into the top of the incoming section.

   For approximate top entry locations and wiring schemes for main fusible disconnects, main circuit breakers and incoming line compartments, refer to Mains and Incoming Lines Dimension Reference, publication 2100-TD018.

2. Remove the lifting angle and top plate.
3. Modify the top plate for necessary conduit entries.

   This method helps guard against metal chips falling into the MCC, which can cause serious damage to the components.

4. Replace the top plate and lifting angle bolts to guard against dust or dirt from entering the top horizontal wireway.
5. Make sure that all incoming conduit is clear of the horizontal ground bus.

   For approximate location of the horizontal ground bus mounted in the top horizontal wireway, refer to Mains and Incoming Lines Dimension Reference, publication 2100-TD018.

   For space availability for incoming cables, refer to the elevation drawings shipped with assembled MCCs.

Installing Cable

Install the cable when the temperature is above freezing 0 °C (32 °F), unless the cable is suitable for installation at temperatures below freezing. This helps prevent cable insulation from cracking or splitting.

MCCs are rated for use with 75 °C (167 °F) cable. Cable must be sized by using a 75 °C (167 °F) column in NEC Table 310–16 (NEC 2005 Edition). The temperature rating of the lugs is not relevant.

ATTENTION: Properly connect all line and load cables to avoid a bolted fault and equipment damage.

Lugs

Follow this procedure to install the lugs.

1. Verify the compatibility of wire size, type, and stranding versus the power lugs furnished.

   Use correct lugs in all applications.

2. Crimp compression lugs with manufacturer recommended tools.
3. Use the MCC electrical schematics to verify field wiring connection points.

Incoming Line Compartment

Top or bottom entry to the incoming line-section bus is straight through to the connection terminals. The vertical bus provides pads for the incoming lugs. Base the lug selection on the size, number, and type of conductor.

- Use of mechanical screw-type lugs is acceptable only when the incoming lines' available short-circuit current is 42,000 A rms symmetrical or less.
- Use of crimp or compression type lugs is acceptable when the incoming lines' available short-circuit current does not exceed 100,000 A rms symmetrical.

Main Disconnect

Top entry is straight through to the line side of the main fusible disconnect or main circuit breaker. For bottom entry, the connection scheme varies depending on the rating of the main device. In some cases, the bottom entry connects to the top or line side of the main fusible disconnect or main circuit breaker. In other cases the connection is reverse-fed, the bottom entry cables connect to the bottom of the main fusible disconnect or main circuit breaker. For further information refer to Mains and Incoming Lines Dimension Reference, publication 2100-TD018.

Mechanical screw-type lugs are supplied as standard with all main fusible disconnects or main circuit breakers. Crimp or compression lugs are optional.

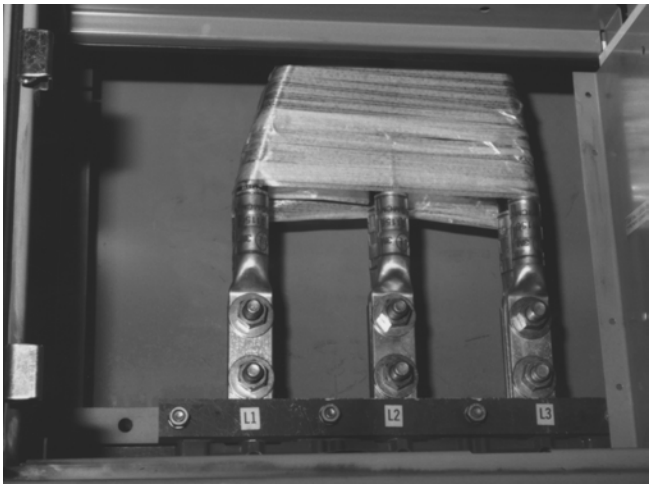
Cable Bracing

The CENTERLINE MCC bus work system has been tested and is qualified to withstand maximum short-circuit forces exceeding the short-circuit withstand ratings for the MCC. Incoming line cables and outgoing feeder cables also need to be supported to withstand the same short-circuit forces. Follow NEC and local codes when bracing incoming and outgoing cables. There are many sizes and types of cables, as well as different means that the cables can be supported. Acceptable methods are shown on the following pages.

Securing Cables with Glass Tape

In this example, glass fiber-reinforced tape or glass filament tape is used. Make sure the taping is continuous from the point the cables enter the MCC to the point the cables are terminated. It is important that cables are wrapped several times for additional strength. Draw up the cable slack during wrapping so that individual cables are supported by the tape as a single mass.

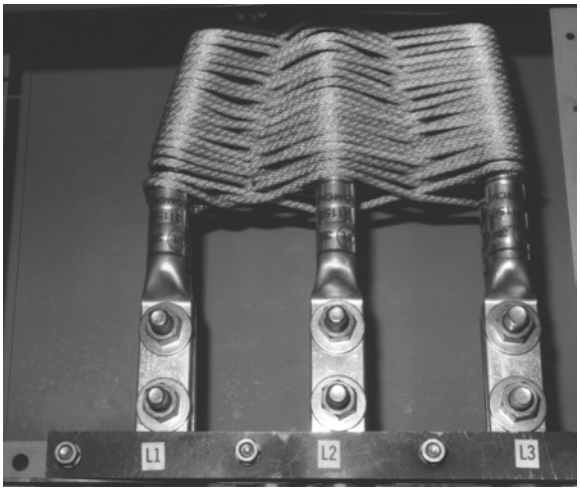
Figure 25 - Securing Cables with Glass Tape



Securing Cables with Nylon Rope

In this example, cables are lashed in a 'figure 8'-type configuration by using nylon rope. Make sure the rope lashing is continuous from the point the cables enter the MCC to the point the cables are terminated. Other types of rope lashing can be acceptable. Draw up cable slack during wrapping so that individual cables are supported by the rope as a single mass.

Figure 26 - Securing Cables with Nylon Rope



Securing Cables with Hardwood

In this example, a hardwood brace (maple hardwood) made for the specific application is used. Holes are bored approximately the size of the cable diameter. Several bolt holes are also bored the breadth of the hardwood brace. The brace is cut in two pieces and is used as a clamp to secure the cables. Through bolts are inserted into the brace and tightened so that cables are held tightly in place.

Figure 27 - Securing Cables with Hardwood

A second form of hardwood brace (not shown) is a yolk type, in which the cables are passed through. Make sure the holes are small enough to provide a snug fit for the cables. The connectors or lugs are attached to the cables and cables are bolted to the terminals.

When using the hardwood bracing method and the short circuit current is less than 42,000 A, brace the cables every 12 in. (305 mm). When the short circuit current is 42,000 A or greater, brace the cables every 6 in. (153 mm).

Incoming Line Brace

Allen-Bradley manufactures an incoming line brace similar to the hardwood clamping-type brace. To order an incoming line brace, contact your local Allen-Bradley distributor or Rockwell Automation sales representative and reference assembly number 40113–848.

IMPORTANT	Install lugs so they are in line with each other and proper spacing is used between phases. Hardware must be torqued per the torque tables found on the enclosure door.

Notes:

Installing and Removing Plug-in Units

ATTENTION: When installing or removing MCC units, when possible, de-energize, lockout, and tag-out all sources of power to the MCC. If the MCC units are installed or removed with power applied to the main power bus, follow established electrical safety work practices. Refer to the NFPA 70E Standard for Electrical Safety in the Workplace publication.

ATTENTION: Review your company safety lockout and tag-out procedure.

De-energize all units before installing or removing.

ATTENTION: All covers and doors must be in place before applying power to the MCC. If units are removed, they must be replaced with the appropriate items such as units, doors, and unit support pans.

ATTENTION: When installing units for CENTERLINE 2100 Motor Control Centers with the ArcShield rating, you must make sure you are installing a unit that has the same arc resistance rating as the MCC in which it is being installed. The arc resistance rating can be found on the ArcShield label on the vertical wireway door.

Units that are not rated for 100 ms arc duration must not be installed in a section that is rated for 100 ms arc duration. The arc resistant rating does not apply if that is done.

Installing Plug-in Units

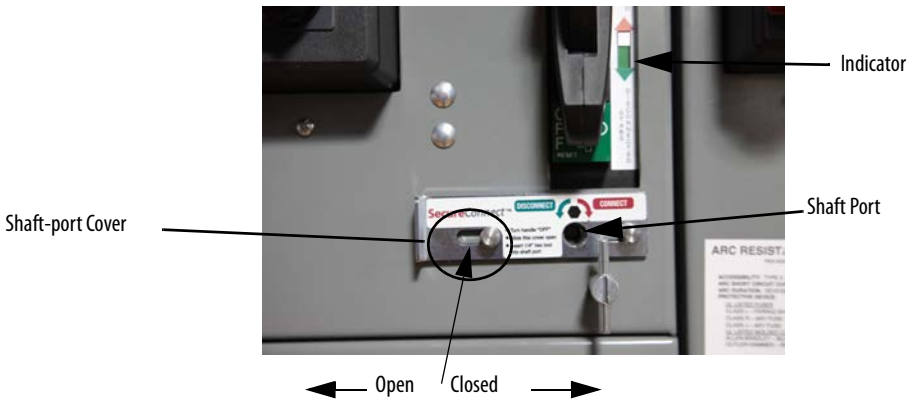
For unit installation, refer to CENTERLINE 2100 Motor Control Centers (MCC) Units with Vertical Operating Handles Installation Instructions, publication 2100-IN014, and CENTERLINE 2100 Motor Control Center (MCC) Units with Horizontal Operating Handles Installation Instructions, publication 2100-IN060.

Remove a SecureConnect Unit from a Section

Follow these steps to remove a SecureConnect™ unit from a section.

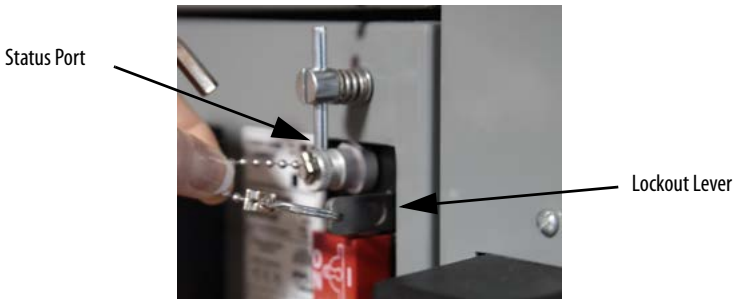
1. Make sure the disconnect handle is in the OFF/O position.
2. Slide the shaft port cover open.
3. Insert the 1/4 in. hex tool into the shaft port.
4. Rotate the wrench counter-clockwise to retract the power stabs.

   The indicator next to the disconnect handle changes from red to green.



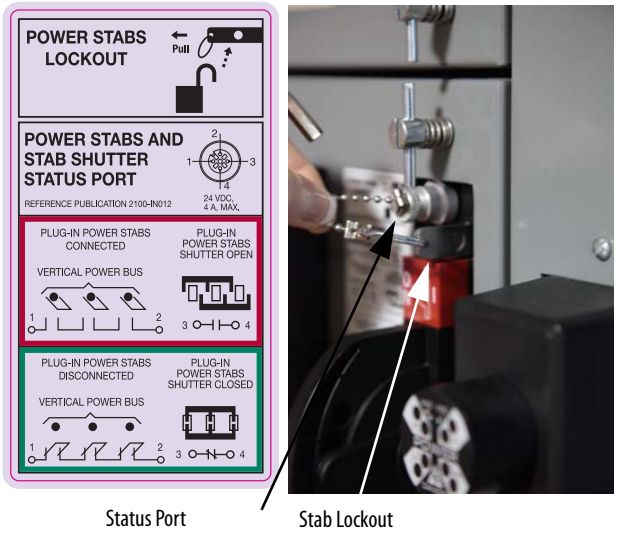
5. Pull out the power stabs lockout lever.

   You can attach a lock to the lever to prevent the lever from being pushed in and the power stabs being extended.



6. Remove the cover from the status port.

7. Connect a multi-meter to the status port to verify that there is a closed connection.



   a. Verify that the stabs are retracted by checking the continuity in pins 1 and 2.

      When the stabs are retracted, they complete the circuit verifying that all three stabs have retracted completely.

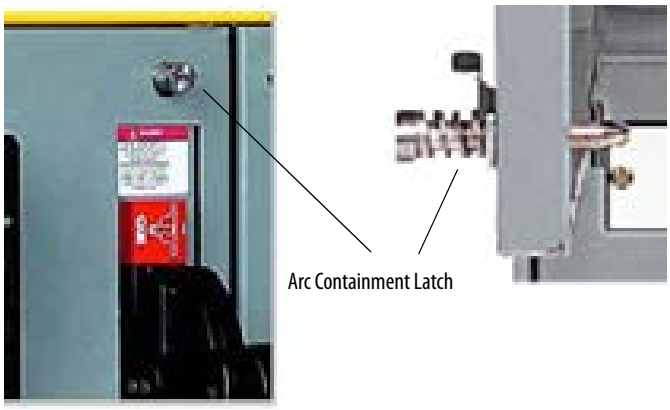
   b. Verify that the stab housing shutters are closed by checking continuity in pins 3 and 4 of the status port.

      A limit switch provides feedback to indicate the stab housing shutters are closed.

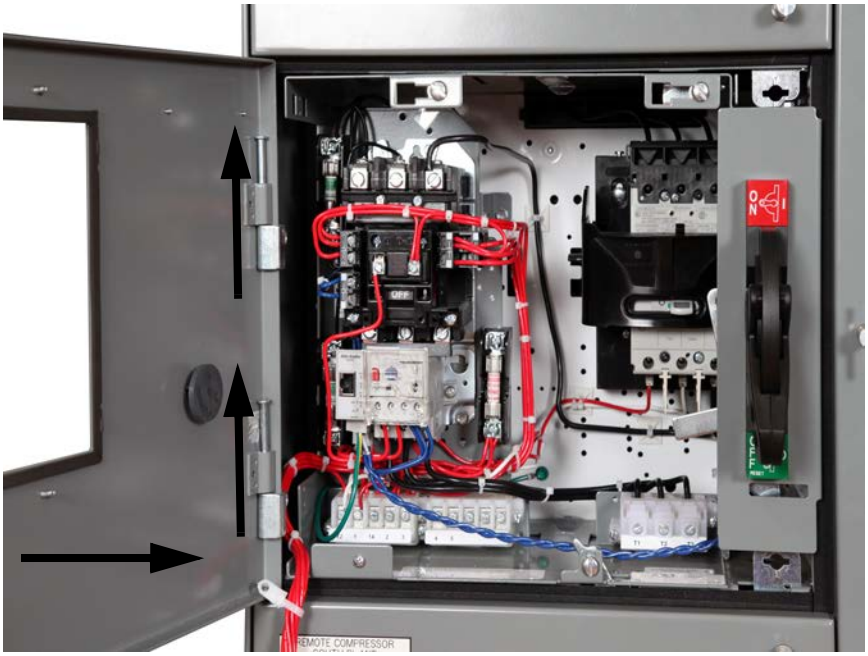
8. Continue following the steps with Remove a Plug-in Unit with a Vertical Operating Handle from a Section on page 51.

Remove a Plug-in Unit with a Vertical Operating Handle from a Section

1. Make sure the disconnect handle is in the OFF/O position.
2. For non-arc resistant units, turn the door latches 1/4 turn; for units that are equipped with arc-resistant door latches, push in the latch and rotate 1/4 turn.



3. Open the door completely.



4. Remove the unit door, if necessary.

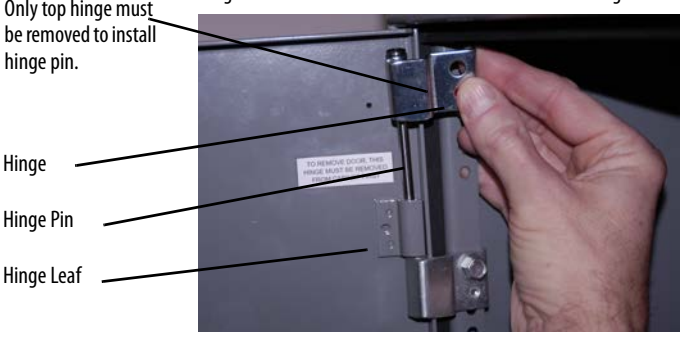
TIP It is not necessary to remove the unit door to remove a unit from a section. However, these steps can still be necessary even when the door is not removed.

a. Remove the door-mounted devices and wiring, if necessary.

b. Remove the hinge pins by sliding upward with a flathead screwdriver.

For Units With	Follow This Step
A control station	First slide the hinge pin out of the hinge and through the tab on the control station wiring.
ArcShield units with 100 ms arc duration rating	Two hinges are required for each hinge leaf. 1. The upper hinge on each door must be removed from the structure to remove the uppermost hinge pin. 2. Remove the hinge pin through the lower hinge, then through the hinge leaf and upper hinge.

Hinge for ArcShield Units with 100 ms Arc Duration Rating



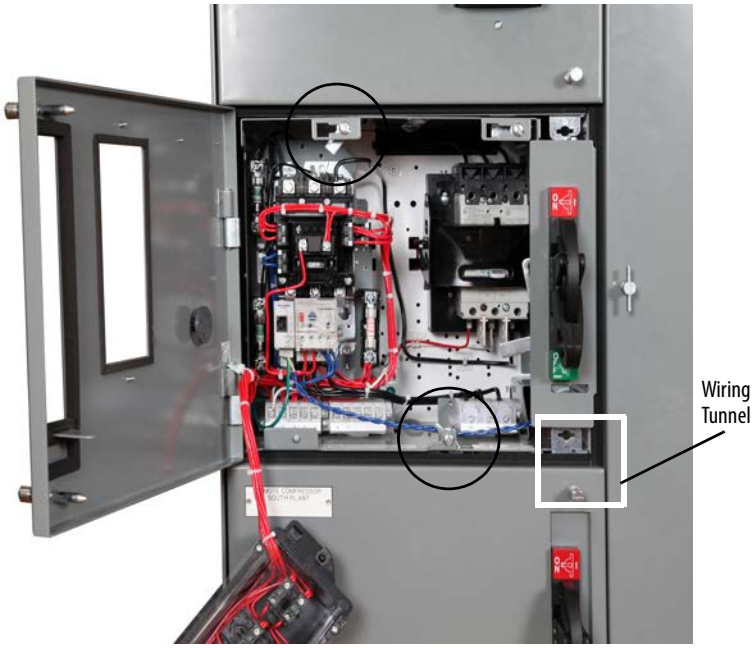
The control station can be hung on the front of the unit by using square holes adjacent to the top unit latch.

c. Swing the door to near closed position.

d. Lift the door outward to remove.

5. Disengage the captive latches at the front of the unit, one at the top and one at the bottom of the unit.

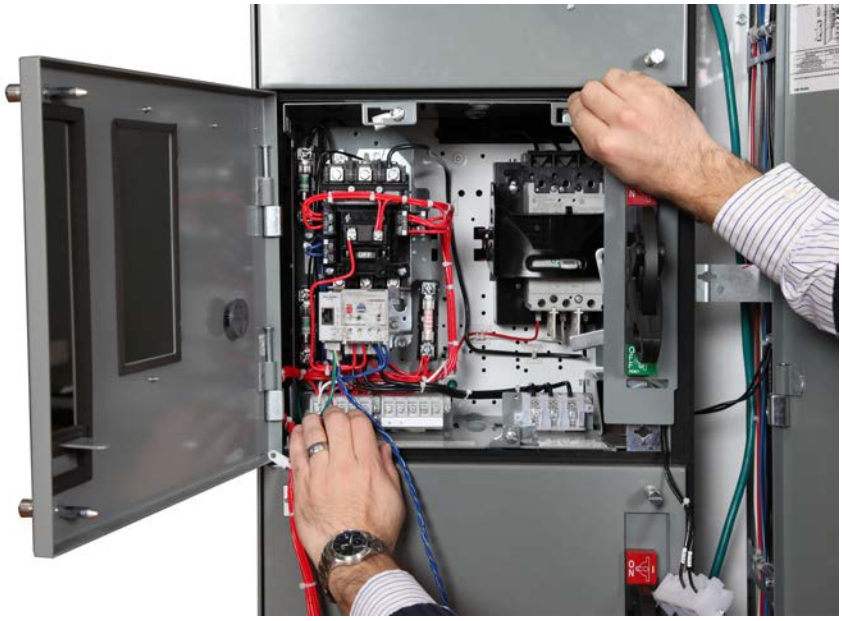
   Units that are 2.0 space factor and larger have two latches at the top. All units with the 100 ms arc-resistant rating have two latches at the top.



6. Detach the front portion of the pull-apart terminal blocks from the unit base and place the wires and terminal blocks in line with the wiring clearance tunnel.

7. Remove other cables or devices that can prevent the unit from being withdrawn.

   TIP It is not necessary to place wires and terminal blocks into the vertical wireway to remove a plug-in unit that includes the wiring clearance tunnel.

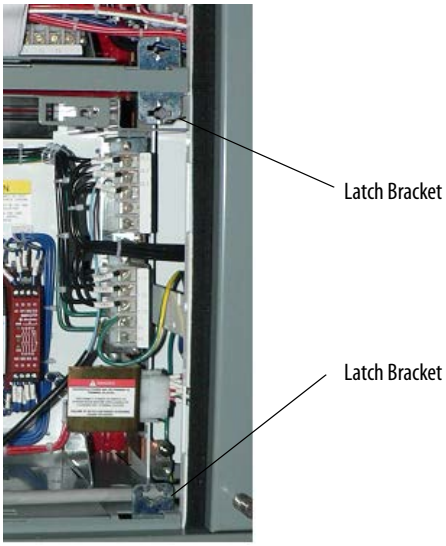


8. Pull the unit forward (outward) approximately 3 in. (7.5 cm) out of the MCC by using the handle provided at the lower left of the unit and the tab in the upper right of the unit as finger holds.

   Reposition your hands, as necessary, to properly support the unit while you are removing the unit from the MCC.

ATTENTION: Plug-in MCC units can be heavy or awkward to handle. Use an assistant or a platform lift device, if necessary, to help you handle the unit.

For the CENTERLINE 2100 MCC units with arc-resistant door latches, you can tilt the top of the unit slightly to the rear to avoid interference with the top arc latch bracket before removing the unit. If you do not have enough clearance, you need to loosen the latch bracket screw (approximately two turns) to remove the unit.



TIP For dual-mounted, fusible-feeder disconnect switch units, you need to remove the bottom arc latch bracket. You can do this by first removing the unit below the dual disconnect unit.

9. Remove the unit from the MCC.
10. Carefully install protective caps or close manual shutters after the unit is removed.

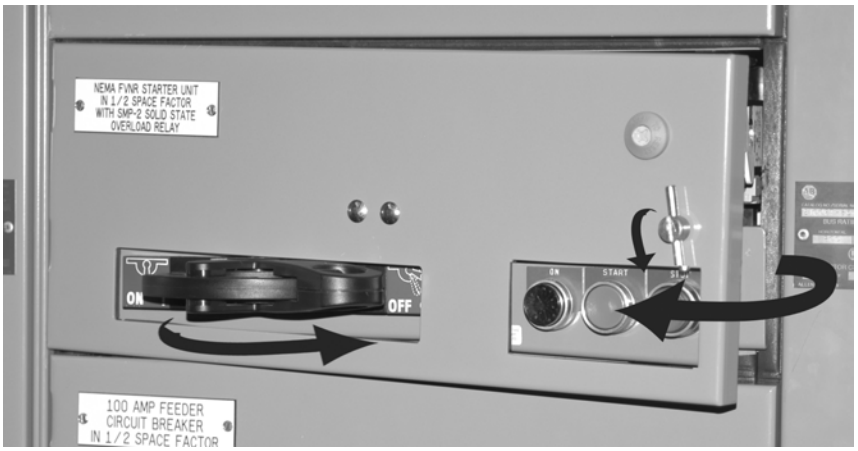
    Automatic shutters close as units are removed.

ATTENTION: All covers and doors must be in place before applying power to the MCC. If units are removed, they must be replaced with the appropriate items such as units, doors, and unit support pans.

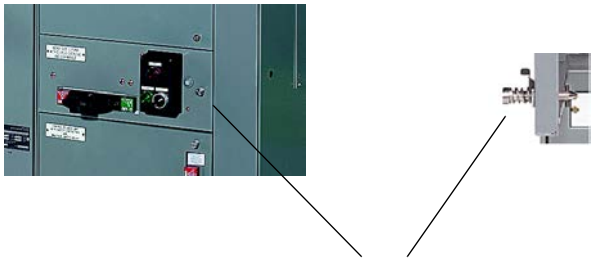
When installing units for CENTERLINE 2100 Motor Control Centers with the ArcShield rating, you must make sure you are installing a unit that has the same arc resistance rating as the MCC in which it is being installed. The arc resistance rating can be found on the ArcShield label on the vertical wireway door.

Units that are not rated for 100 ms arc duration must not be installed in a section that is rated for 100 ms arc duration. The arc resistant rating does not apply if that is done.

Remove a Plug-in Unit with a Horizontal Operating Handle from a Section



1. Make sure the disconnect handle is in the OFF/O position.
2. For non-arc resistant units, turn the door latch 1/4 turn; for units that are equipped with arc-resistant door latches, push in the latch and rotate 1/4 turn.



3. Open the door completely.
4. Remove the unit door, if necessary.

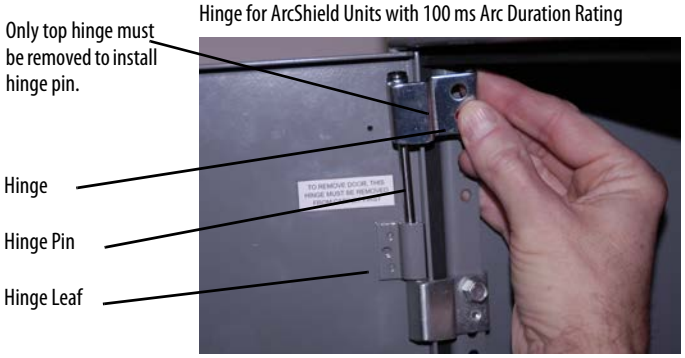
TIP It is not necessary to remove the unit door to remove a unit from a section. However, these steps can still be necessary even when the door is not removed.

   a. Remove the door-mounted devices and wiring, if necessary.

b. Remove the hinge pins by sliding upward with a flathead screwdriver.

For Units With	Follow This Step
A control station	First slide the hinge pin out of the hinge and through the tab on the control station wiring.
ArcShield units with 100 ms arc duration rating	Two hinges are required for each hinge leaf. 1. The upper hinge on each door must be removed from the structure to remove the uppermost hinge pin. 2. Remove the hinge pin through the lower hinge, then through the hinge leaf and upper hinge.

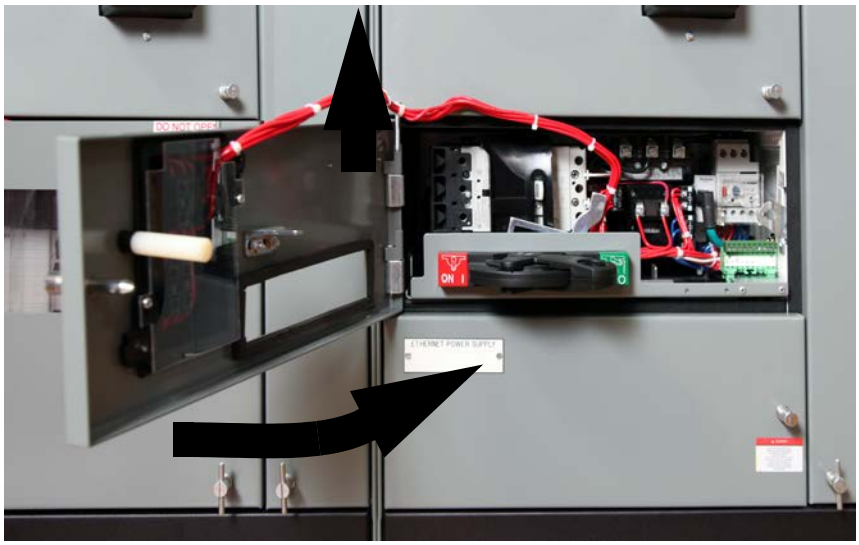
Hinge for ArcShield Units with 100 ms Arc Duration Rating



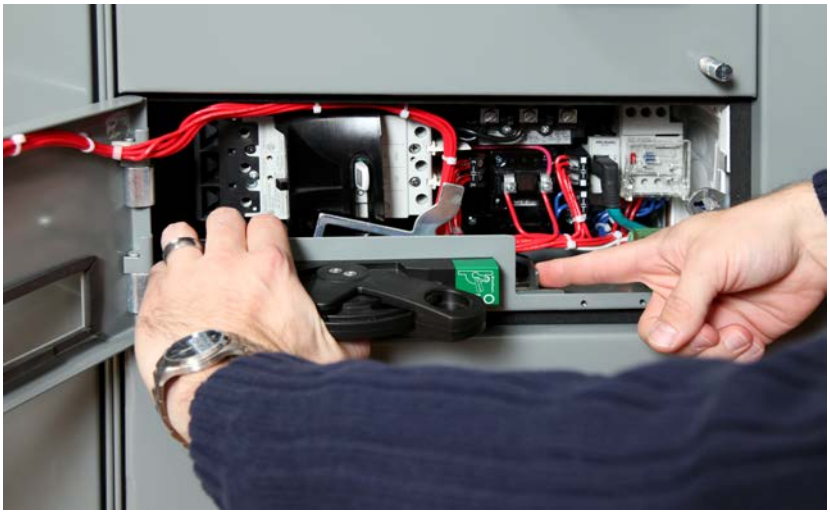
The control station can be hung on the front of the unit by using square holes adjacent to the top unit latch.

c. Swing the door to near closed position.

d. Lift the door outward to remove.



5. Detach the wiring/terminal block from the unit.
6. Place the wiring/terminal block in the vertical wireway to the right of unit.



7. Push the latch mechanism to the left with your right hand.
8. Pull the unit forward (outward) approximately 3 in. (7.62 cm) out of the MCC.

   You can reposition your hands, as necessary, to properly support the unit while you are removing the unit from the MCC.

For the CENTERLINE 2100 MCC units with swing-out door latches, you need to rotate the latch bracket 90° clockwise to avoid interference with the unit.

ATTENTION: Plug-in MCC units can be heavy or awkward to handle. Use an assistant or a platform lift device if necessary to help you handle the unit.

9. Remove the unit from the MCC.
10. Carefully install protective caps or close the manual shutters after unit is removed.

ATTENTION: All covers and doors must be in place before applying power to the MCC. If units are removed, they must be replaced with the appropriate items such as units, doors, and unit support pans.

Automatic shutters close as units are removed.

11. See the next section for additional information.

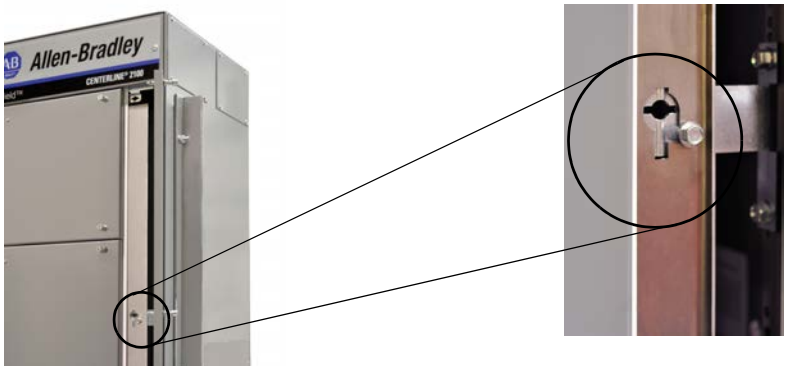
ATTENTION: All covers and doors must be in place before applying power to the MCC. If units are removed, they must be replaced with the appropriate items such as units, doors, and unit support pans.

When installing units for CENTERLINE 2100 Motor Control Centers with the ArcShield rating, you must make sure you are installing a unit that has the same arc resistance rating as the MCC in which it is being installed. The arc resistance rating can be found on the ArcShield label on the vertical wireway door.

Units that are not rated for 100 ms arc duration must not be installed in a section that is rated for 100 ms arc duration. The arc resistant rating does not apply if that is done.

Remove the Support Pan

1. For ArcShield sections with 100 ms arc duration rating, remove the vertical wireway baffle and set aside for installation later.

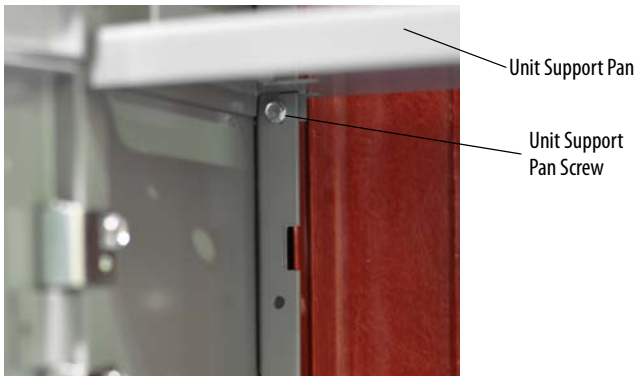


2. Pry the plastic retaining clip from the right-hand unit support by using a screwdriver.

   This is visible in the vertical wireway.

For CENTERLINE MCC units with arc resistant latches, the unit support pan is secured to the right-hand unit support by the screw that retains the arc latch bracket. To remove the unit support pan, you must remove the arc latch bracket.

For CENTERLINE MCC units with the 100 ms arc duration rating, there is an additional screw that secures the unit support pan. This screw is at the left-rear corner of the unit support pan.



3. Lift the right side of the support pan approximately 4 in. (102 mm).

4. Pull the right side of the support pan forward to release from the left rear slot on the structure.
5. Push back on the left side of the support pan until the support pan is free from the structure.

   Vertical sections can be supplied with plug-in stab opening protective caps, manual shutters, or automatic shutters. Refer to the next step if any of these options are supplied.
6. Carefully install the protective caps or close the manual shutters after the unit is removed.

   Automatic shutters close as the units are removed.

ATTENTION: All covers and doors must be in place before applying power to the MCC. If units are removed, they must be replaced with the appropriate items such as units, doors, and unit support pans.

Notes:

Arc Flash Protection Marking as Required by the National Electrical Code

Flash Protection Marking Requirement

The flash protection marking requirement was initially established in 2000 by The National Fire Protection Association (NFPA 70E), Standard for Electrical Safety Requirements for Employee Workplaces. NFPA 70E applies to workers who install, maintain, or repair electrical systems.

In 2002, NFPA 70, The National Electrical Code (NEC) added the Article 110.16, and reinforced the flash protection marking of equipment. The 2002 version of the article is stated below.

110.16 Flash Protection

> Switchboards, panelboards, industrial control panels, and MCCs that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.
>
> FPN No. 1: NFPA 70E-2000, Electrical Safety Requirements for Employee Workplaces, provides assistance in determining severity of potential exposure, planning safe work practices, and selecting personal protective equipment.
>
> FPN No. 2: ANSI Z535.4-1998, Product Safety Signs and Labels, provides guidelines for the design of safety signs and labels for application to products.

As Arc Flash Technology emerges, new developments have caused changes to arc flash criteria. For example, in 2004, the NFPA 70E was reissued in a completely new format along with changes reflecting new developments. The NEC is revised every three years and the NFPA 70E is revised every four years. Use the latest editions of the NEC and NFPA 70E in establishing potential electric arc flash hazards and arc flash marking.

Arc Flash Marking Clarification

The flash protection marking per NEC Article 110.16 is a field marking requirement and is to be applied by the MCC end-user for each specific application. The marking is similar to other NEC marking requirements, for example, voltage, voltage hazard labels, and circuits. However, flash protection markings must be based on application information and calculations from the installation site. The intent of the marking is to identify the presence of a potential flash hazard and to provide assistance in determining necessary protective clothing and personal protective equipment (PPE) that is worn by qualified electrical persons when servicing electrical equipment. You must establish field marking requirements based upon the following:

- The level of the on-site personnel safety training
- The level of required clothing and required PPE
- Consistency for the level of marking of various equipment, for example, switchboards, panelboards, industrial control panels, and MCCs
- The available flash energy on each piece of equipment.

  This energy is determined from available fault current, arc flash duration due to the type, and degree of short circuit protection equipment.

Rockwell Automation Services

Rockwell Automation understands the importance of you fulfilling the field arc-flash hazard marking requirements as defined by Article 116.10 in the NEC. Rockwell Automation can assist you in determining the necessary arc flash marking as required by NFPA 70E.

Rockwell Automation offers services that can provide assistance in the following areas:

- Arc-flash hazard analysis
- Providing input on the specific Bulletin 2100 MCC design being used
- The zone determination for the NFPA 70E Hazard/Risk levels
- Your required NEC field marking

For information regarding arc-flash hazard analysis, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Operator Handle and Unit Interlock

The operator handle is an integral part of each MCC unit. Adjustment of the handle is not required. The operator handle is interlocked with each unit door as outlined by UL 845.

Defeating the Unit Door Interlock

Refer to the following information for defeating the unit door lock.

Open the Door When the Operating Handle Is in the ON/I Position

ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

When the unit door is closed and the operator handle is in the ON/I position, a defeater screw must be deliberately operated to open the unit door (for example, opening the door of an energized unit).

The defeater screw is just below (on units with a vertically mounted operator handle) or just to the right (on units with a horizontally mounted operator handle) of the pivot point of the operator handle. To operate the defeater mechanism and defeat the door interlock while the operator handle is in the ON/I position, use a flat-head screwdriver to turn the defeater screw clockwise one-eighth to one-quarter turn.

ATTENTION: Opening the door reduces arc flash safety.

ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

Personal protective equipment (PPE) is not shown for clarity.

Figure 28 - Operating Handle Defeater for Vertical Operator Handle

Figure 29 - Operating Handle Defeater for Horizontal Operator Handle

Defeating the Unit Interlock Lever

Refer to the following information for defeating the unit interlock lever.

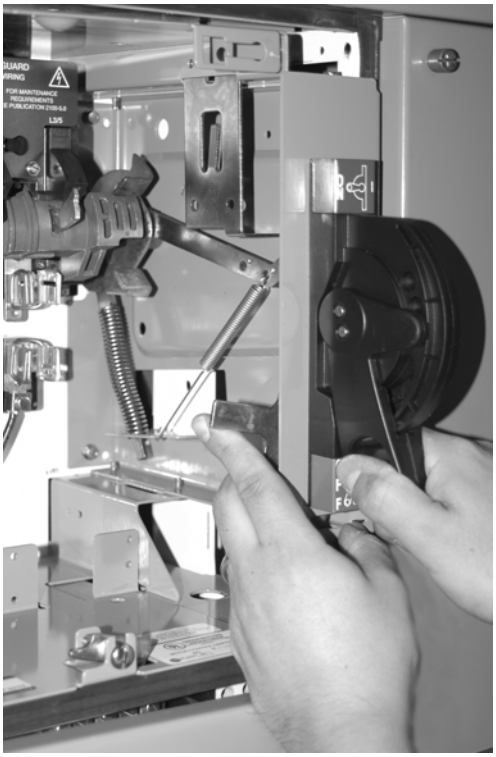
Energize a Unit with the Unit Door Open

ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

Personal protective equipment (PPE) is not shown for clarity.

When the unit door is open and the operator handle is in the OFF/O position, the defeater lever must be deliberately lifted on the vertical handles or pushed to the left for horizontal handles, to move the operator handle to the ON/I position, and energize the unit.

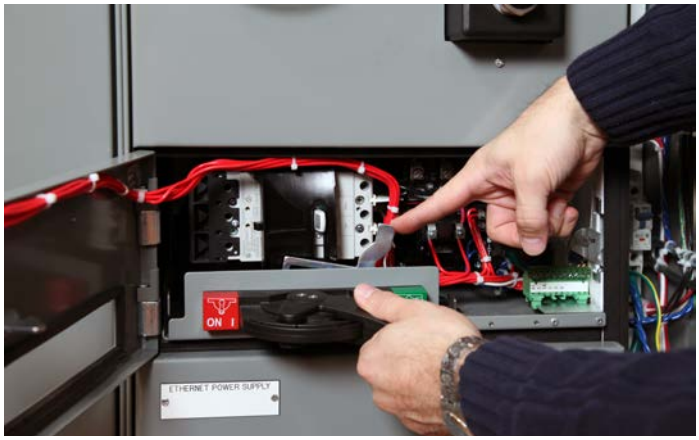
Figure 30 - Defeater Lever for Vertical Operator Handle



ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

Personal protective equipment (PPE) is not shown for clarity.

Figure 31 - Defeater Lever for Horizontal Operating Handle



Locking Provisions

Refer to the following sections for locking provisions.

Lock Vertical Operating Handles in the OFF/O Position

ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

To lock the small, medium, and large operator handle in the OFF/O position, put the shackle of the lock through the opening in the operator handle assembly. The opening can accommodate up to three padlocks.

Figure 32 - Locking Vertical Handles in OFF/O Position

Small and Medium Vertical Handle

Large Handle

Lock Horizontal Operating Handles in the OFF/O Position

Some units use a horizontal operating handle. The horizontal operating handle can be locked in the OFF/O position by putting the shackle of the lock through the open slotted area to the left of the operator handle.

Figure 33 - Locking a Horizontally Mounted Operating Handle in OFF/O Position

Lock Units with Operating Handles in the ON/I Position

ATTENTION: Locking an operating handle in the ON/I position can be in conflict with local codes and emergency shut down requirements.

Follow this procedure to lock the operator handle in the ON/I position.

1. Drill out the hole to 3/8 in. (9.5 mm) diameter maximum.
2. Insert the shackle of the lock.

The following instructions assume that the handle is in the ON/I position:

- For units with small handles, the hole is in the upper portion of the operator handle assembly.
- For units with medium and large operator handles, the hole is underneath the operator handle on the handle assembly.
- For units with a horizontally mounted handle, the hole is on the left-hand side of the handle assembly.

Figure 34 - Locking Small Handle in ON/I POSITION, Vertical Operating Handle

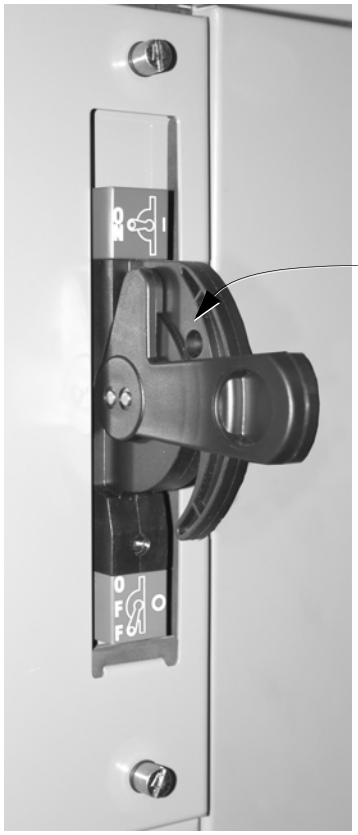


Figure 35 - Locking the Medium Handle in ON/I Position

Figure 36 - Locking Large Handle in ON/I Position

Figure 37 - Locking Horizontal Handle in ON/I Position

Unit Interlocks

A unit interlock is provided with each plug-in unit. Unit interlocks prevent units from being removed from or inserted into a vertical section when the operator handle is in the ON/I position.

Units can also be locked out with a padlock preventing installation of the unit into a vertical section. The lockout feature of the unit interlock can be used with a padlock to keep the interlock in an extended position, which prevents the unit from being inserted into an MCC section. The unit interlock can also be used with the unit installed in the section, but partially removed from the section.

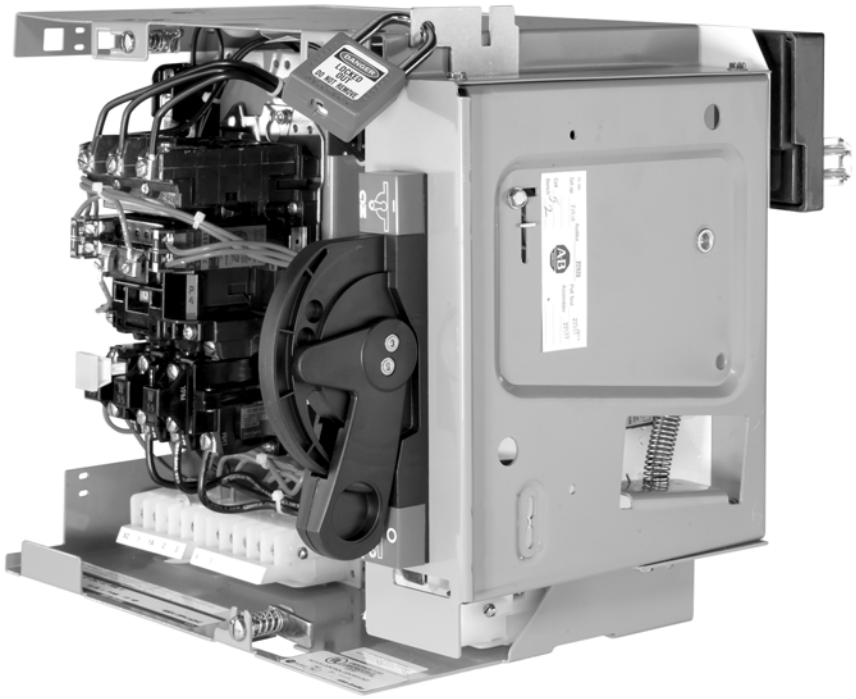
In this position, the unit is partially removed from the MCC and the slot in the interlock plate is in line with the flange of the unit support pan above this unit. When the unit is locked in this position, the unit power and ground stabs are disengaged. This position can be used to prevent insertion of a unit into the MCC.

Figure 38 - Unit Interlock to Prevent Insertion - Vertical Operating Handler

ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

We recommend that maintenance performed on the MCC units be performed away from the MCC in a suitable work area, when possible.

Figure 39 - Unit Interlock to Prevent Insertion - Unit Completely Withdrawn



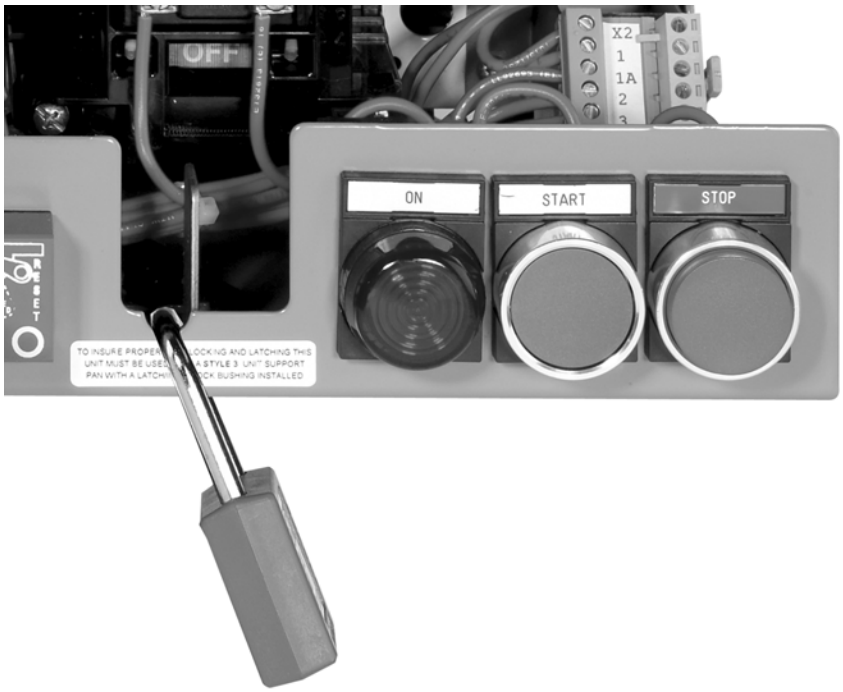
In this position, the unit is partially removed from the MCC and the intermediate slot in the interlock plate is in line with the bushing in the unit support pan. When the unit is locked in this position, the unit power and ground stabs are disengaged. This position can be used to prevent insertion of a unit into the MCC.

Figure 40 - Unit Interlock to Prevent Insertion - Horizontal Operating Handle

ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

We recommend that maintenance performed on the MCC units be performed away from the MCC in a suitable work area, when possible.

Figure 41 - Unit Interlock to Prevent Insertion - Unit Completely Withdrawn



Final Checklist Before Energizing

Introduction

This section provides guidance for the startup of a newly installed MCC.

We recommend making an itemized list including the following:

- Serial number
- Number of sections
- Number of units and their corresponding voltage
- Current ratings
- Horsepower ratings
- Types of circuits
- Fuse sizes
- Circuit breaker ratings and trip settings
- Heater elements requirements
- Arc resistant components
- Other important data

The itemized list could be modeled after the MCC layout drawings supplied with each MCC. Save this itemized list in a file along with other data for the MCC such as, component manuals, heater element instructions, MCC manuals, and wiring diagrams. Blank sample forms are provided at the end of this chapter.

Pre-energizing Check Procedure

Allow only a 'qualified person' to conduct the pre-energizing check. A qualified person is defined by NEMA Standards Publication / No. ICS 2.3, Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers, Section 1 as follows:

> **1.4 Qualified Person**
>
> For the purpose of this guide, a qualified person is one who is familiar with the installation, construction and operation of the equipment and the hazards involved. In addition, he or she has the following qualifications:
>
> 1.4.1 Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
>
> 1.4.2 Is trained in the proper care and usage of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

Perform the Pre-energizing Check Procedure

ATTENTION: To ensure the safety of personnel performing the pre-energizing check, make sure the MCC remote power sources are disconnected and locked in the OFF/O position.

Use a voltmeter to verify that the MCC remote power sources are disconnected.

ATTENTION: Power factor correction capacitors (PFCCs) must be applied correctly. For application instructions refer to Power Factor Correction Capacitors for Bulletin 2100 MCC Starter Units Application Techniques, publication 2100-AT001. When PFCCs are connected to the motor circuit and the start-up procedure requires the respective motors to be jogged, inched, or bumped (rotation direction check), temporarily disconnect PFCCs. For more information contact, Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

ATTENTION: Verify that motor acceleration times are within specific application specifications.

Excessive starting currents and/or acceleration times can cause inverse time circuit breakers, power fuses, overload relays, and other components to overheat and/or shutdown equipment.

1. Remove all blocks or temporary holding means used for shipping all component devices in the MCC.
2. Inspect the enclosure and units for damage.
   a. If structural damage is present, contact MCC technical support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.
   b. If no structural damage is visible, verify the electrical spacings.

      Refer to the tables starting on page 89 for the required minimum electrical spacings.
3. Check and verify that the MCC is properly installed, as described in Chapter 2, and inspect and verify that it is level, supported, and anchored.
4. For MCCs with the 100 ms arc-resistant rating, check that clearance height is at least 12 in. (305 mm).
5. Check the integrity of the bus splice connections.

   Recommended torque values can be found on the information label on the interior of the vertical wireway door or on the interior right-hand side plate of frame mounted units. See Joining and Splicing Vertical Sections, publication 2100-IN010, for splicing information.

The factory-made power bus connections are tightened by a computer-controlled torquing system. The following connections do not require re-torquing:

- vertical to horizontal bus connections.
- power conductor to horizontal bus connections.

  These factory-made horizontal to vertical bus connections do not require servicing for the life of the MCC.

6. Check and verify that all ground connections are made properly, based on local standards.

   If ground bus is not provided or has been removed, check that the MCC sections are connected to provide a continuous ground path. Verify that 100 ms units are connected to the vertical equipment load ground bus.

7. Check the field wiring.
   a. Check the field wiring for proper conductor sizing.

      Use the National Electrical Code (NEC) 75 °C (167 °F) wire tables to size the MCC field conductors.

   b. Check that all barriers and parts that have been removed during installation have been reinstalled.

      Some barriers can be required to be removed for field wiring.

      TIP We recommend that a barrier checklist is developed including such items as, unit location, and barrier location. Save this checklist for future reference.

   c. Check that all incoming and outgoing power wiring is secure and braced to withstand the effects of a fault current as detailed in Chapter 3.

   d. Check that conduit and cabling are well supported.

      For incoming line compartments, 2.0 space factors, 26 in. (660.4 mm) or less, firmly secure the incoming cables halfway between the top of the section and the incoming line compartment terminals. In a full section (6.0 space factor) incoming line compartments, brace the cables every 12 in. (305 mm); if the system's available short circuit current is above 42,000 A but less than 65,000 A rms symmetrical. Above 65,000 A rms symmetrical available current bracing occurs every 6.5 in. (165 mm). This bracing is in accordance with the Underwriters Laboratories (UL) listing and is necessary to withstand forces resulting from high fault currents. For information on cable bracing methods, see Chapter 3 of this publication.

   e. Check the integrity of all field connections.

      Recommended torque values not found on individual devices can be found on the unit wiring diagrams.

   f. Check field wired connections made to the MCC for agreement with wiring diagrams and verify that proper spacings between adjacent phases and/or phases to ground are being used. Refer to page 89 for the minimum electrical spacing requirements.

8. Check that the voltage and horsepower ratings on the motor correspond with the MCC unit ratings.
9. Check that the overload relays or heater elements are selected, installed and/or adjusted to relative full load current shown on the motor rating nameplate.
10. For applications requiring power fuses, install the fuses in the fusible switches in accordance with the NEC application requirements.

    Refer to CENTERLINE Motor Control Centers Power Fuses Product Data, publication 2100-TD003 for fuse information. **Do not apply grease or NO-OX-ID to fuse ferrules.** All fuses must be completely inserted in the fuse clips. Recommended torque values for fuse clamp screws can be found on the unit wiring diagram. Verify that all fuses fit each application.
11. For circuit breaker applications, verify that the circuit breakers are in accordance with NEC application requirements, and have correct ampacity and trip settings.

    Refer to MCC Instantaneous Trip Motor Circuit Protectors (MCP) in Combination NEMA Starter, Soft Starter (SMC), and Variable Frequency AC Drive Units Technical Data, publication 2100-TD001, and MCC Inverse Time Circuit Breakers in Combination NEMA Starter, Soft Starter (SMC), and Variable Frequency AC Drive Units Technical Data, 2100-TD002 for circuit breaker information in MCC units.

IMPORTANT High efficiency motors can have higher locked rotor and inrush currents. Therefore, higher magnetic trip settings, than those required for equivalent standard motors, can be required.

12. Refer to the device instruction sheets or manuals supplied with the MCC for specific start-up guidance. Component devices in MCC units such as transfer switches, PFCCs, transducers, motor protectors, line monitors, over and under-voltage relays, and motor windings heaters can require unique start-up procedures. Set and verify adjustable current, voltage, and other settings, according to device instructions or wiring diagrams.

    Allen-Bradley AC drives and soft starter units are shipped with preset factory settings such as ramp speed, current limits, switch positions, and readouts. Preset factory settings are not be suitable for many applications. Refer to instruction manuals, supplied with the MCC for specific startup guidance.

ATTENTION: Verify that the parameters of configurable devices, such as drives, soft starters, and overload relays, are suitable for the specific application and change them as needed for the specific application.

13. Manually exercise all switches, control auxiliary switches, circuit breakers, their respective operators, unit interlocks, trip mechanisms (test by pushing the 'Push to Trip' button), and any other operating mechanisms to verify proper operation.

14. Check timing relay settings as required.
15. Check the vents and fans.
    a. Check all vents to ensure they are free from obstructions.
    b. Check all fans, used for forced air cooling to ensure the shaft rotates without obstructions.
    c. Check that filters are in place and clean, and set up an in-house program for scheduled cleaning or replacement.

    If you have an MCC with arc-resistant design features, if a unit has been provided with arc resistant baffles over door vents and fans, these baffles must be fastened securely in place to maintain the arc resistant capabilities of the MCC. Do not install any type of filter in place of, or in addition to, the arc resistant baffles.

ATTENTION: Current transformer secondaries are to be 'closed'. To avoid possible injury and electrical shock to personnel, do not energize a current transformer with its secondary open.

16. Check all current transformers for proper polarity and ensure their secondaries are not 'open', but are either connected to their respective devices or 'shorted.'
17. **Recheck that all barriers and parts that have been removed during installation have been reinstalled.**

    Refer to your barrier checklist, see step 7.
18. Before closing the enclosure and/or individual units, remove all tools, metal chips, scrap wire and other debris from the MCC interior.

    If there is an accumulation of dust or dirt, clean out the MCC by using a brush, vacuum cleaner, or clean, lint-free rag. **Do not use compressed air; it redistributes contaminates on other surfaces.**

ATTENTION: When conducting an electrical insulation resistance test, isolate equipment sensitive to high test voltages, such as meters, solid state devices, motor winding heaters, and capacitor units.

19. Conduct an electrical insulation resistance test to verify the MCC wiring integrity.

    Conduct this test by using an insulation resistance tester (megger) with a potential of 500...1000V. Conduct this megger test phase-to-phase, phase-to-ground, and when applicable, phase-to-neutral on the MCC buswork. Conduct the test with all of the switches or circuit breakers in the open or OFF/O positions. Typical insulation resistance values are 50 MΩ or greater.

Next, check the field wiring; for example, motor cables and incoming line cables. Insulation resistance values are affected by temperature, humidity, or dampness, which can cause a considerably lower insulation resistance reading. If the insulation resistance values are below 1 MΩ (for example, affected by dampness, temperature, or humidity) or the MCC has been stored in a damp or humid area, we recommend that the equipment be dried out. Dry out the motor cables by injecting a low voltage current or by using space heaters.

Once the equipment is dry, repeat the insulation resistance test. The minimum value for insulation resistance on a new installation at startup or energizing is 1 MΩ Record these readings in the Megger Reading Recording Table. Use this table to record additional megger readings during regular maintenance periods.

20. Check that all arc-resistant parts are installed.

See ArcShield Components for more information.

21. Check that all unit latches are secure.

See Door Latch Position Diagrams for more information.

22. Check that all section closing plates are in place.

23. Check that any SecureConnect units are properly installed.

See SecureConnect Unit Checklist for more information.

24. Close and latch all doors, making certain that no wires are pinched.

Certain applications can have latch requirements different from those provided. If you have questions regarding proper latching, contact Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

Refer to the following illustrations for various latch placements.

Door Latch Position Diagrams

Figure 42 - Vertical Wireway Door

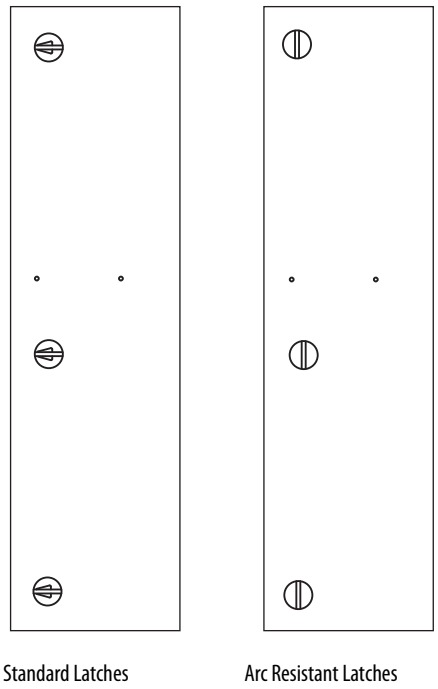


Figure 43 - 0.5 Space Factor and Units with Horizontal Disconnect Handles

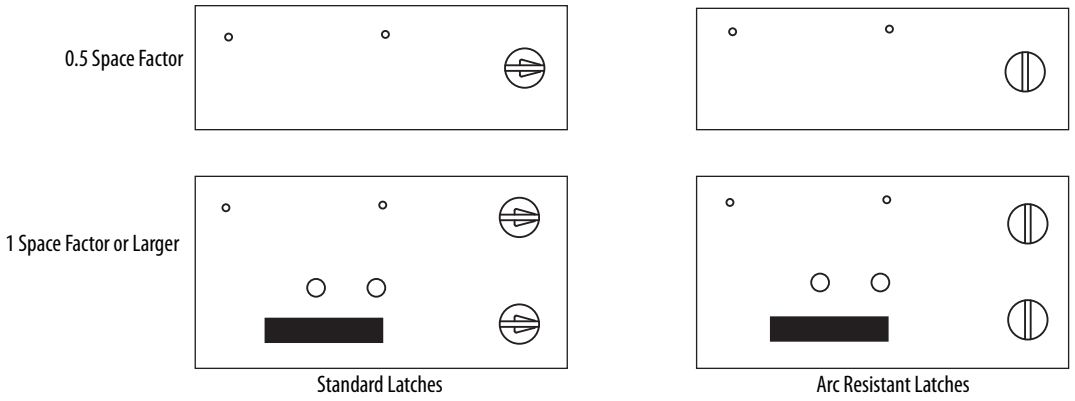
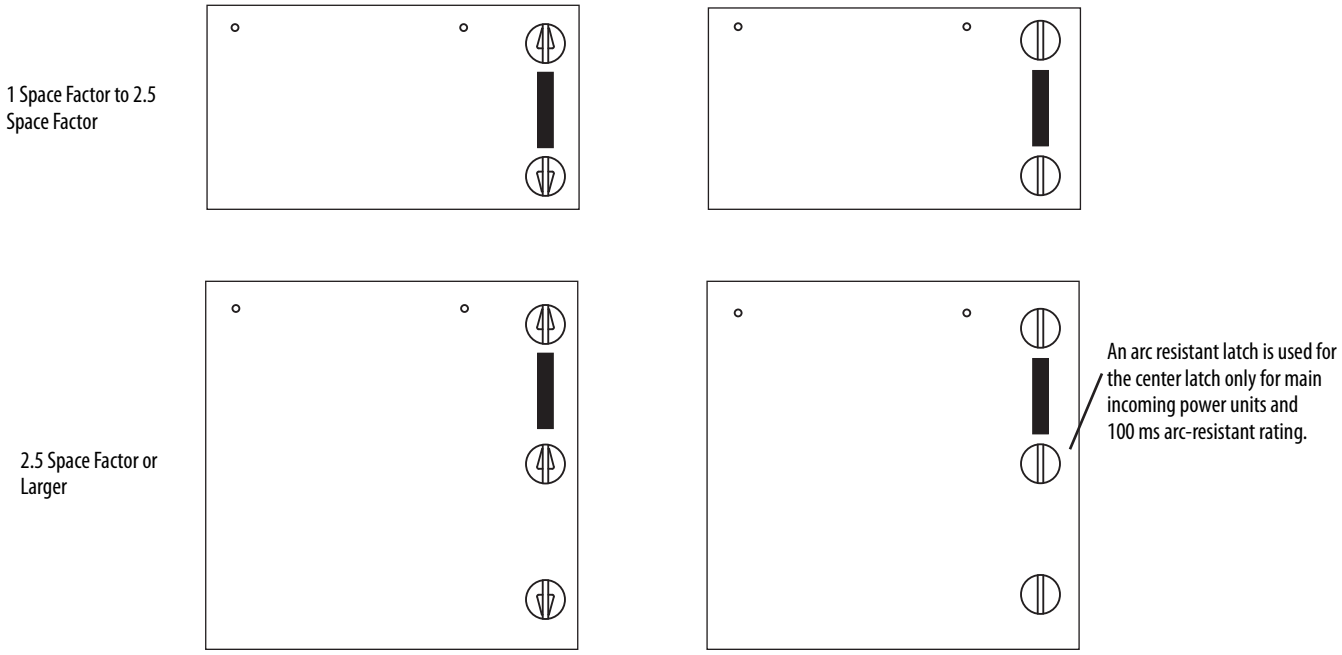
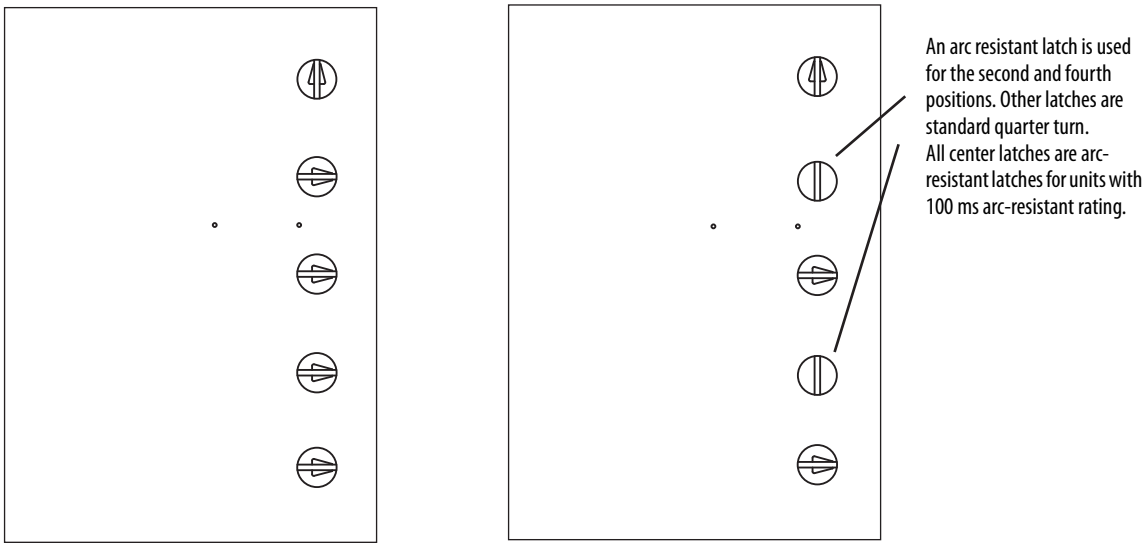


Figure 44 - 1.0 Space Factor and Units with Vertical Disconnect Handles


1 Space Factor to 2.5 Space Factor
2.5 Space Factor or Larger
An arc resistant latch is used for the center latch only for main incoming power units and 100 ms arc-resistant rating.
Standard Latches
Arc Resistant Latches

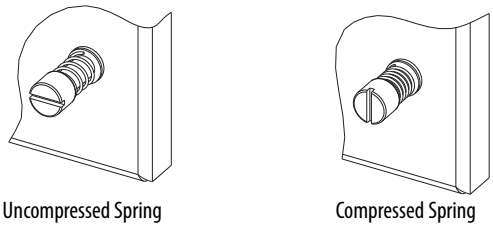
For most units, the center latch is a standard quarter-turn latch. For some units a multi-turn latch is used.
Torque the latch to 20 lb•in +/- 2 lb•in.

Figure 45 - 6 Space Factor (full section) Units


An arc resistant latch is used for the second and fourth positions. Other latches are standard quarter turn.
All center latches are arc-resistant latches for units with 100 ms arc-resistant rating.
Standard Latches
Arc Resistant Latches

When properly latched, the slots on all arc resistant latches are vertical and the latch springs are compressed. The spacing of the spring coils are decreased.

Figure 46 - Spring Compression



ArcShield Components Checklist

ATTENTION: Arc resistant CENTERLINE 2100 MCCs are provided with certain components to achieve the arc-resistant rating. These components must be in place prior to using the MCC to maintain the arc resistant capabilities.

TIP Not all of the components and features necessary for the arc-resistant rating are shown in these images.

Figure 47 - Arc-resistant MCC with Insulating Sheet (15 in. deep, right side visible)

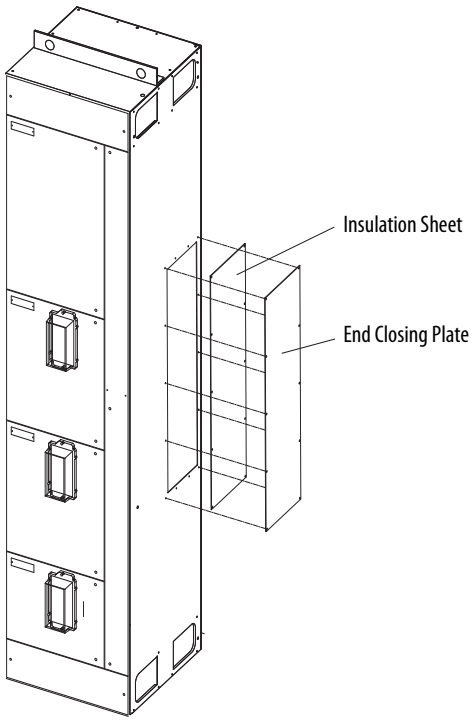
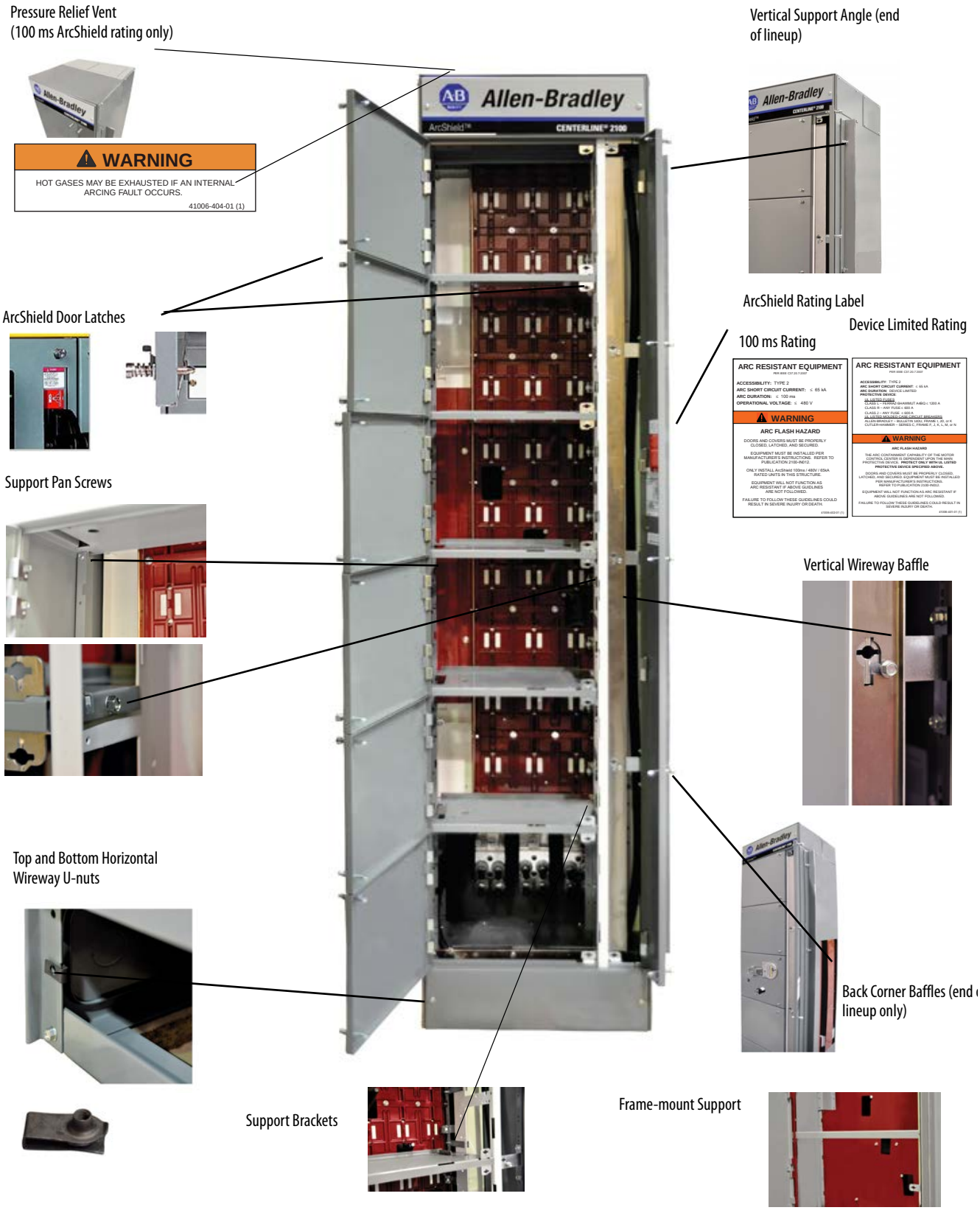


Figure 48 - ArcShield Components

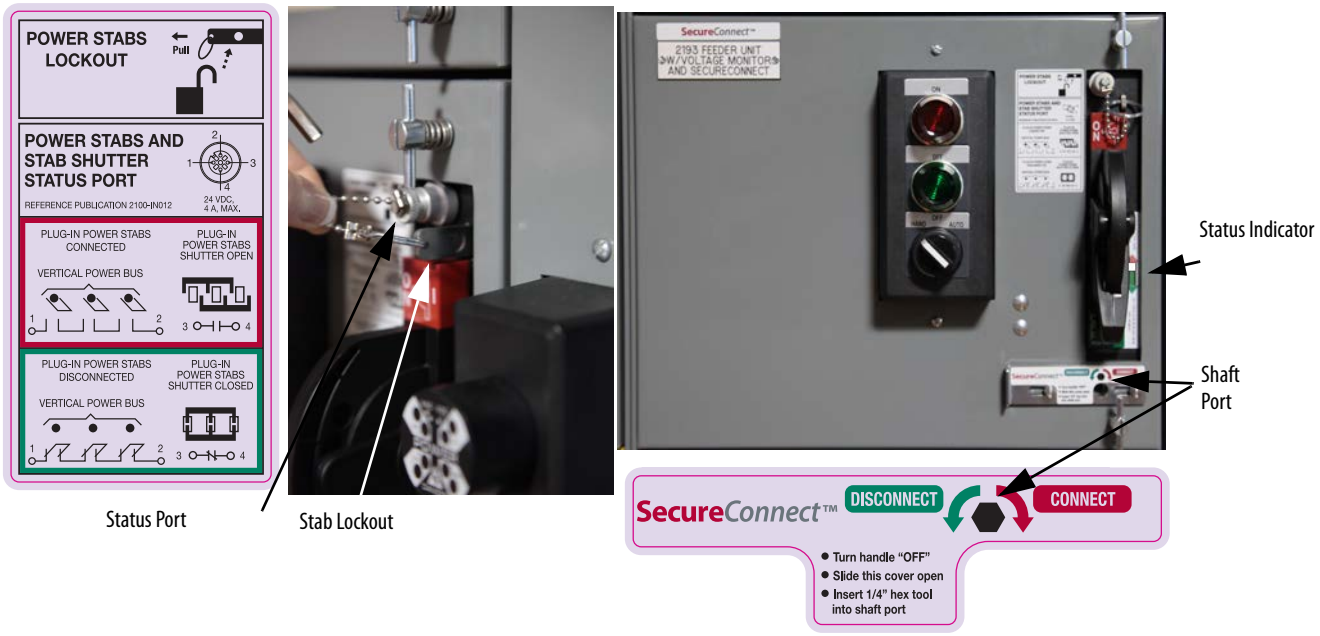


SecureConnect Unit Checklist

Verify these items before using a SecureConnect unit.

1. Make sure the stab lockout is pushed in.
2. Verify the disconnect handle is OFF/O.
3. Insert the tool in the shaft port and rotate the tool to the right.

   The status indicator changes from green to red.



ATTENTION: SecureConnect units are shipped inside the unit location with stabs in the disconnected position. Prior to powering your horizontal bus, you need to place all SecureConnect units in the connected position.

Required Minimum Electrical Spacing

Table 7 - Electrical Spacing Requirements for MCCs(1)

Voltage	Min Spacing, in. (mm)		
	Between Live Parts of Opposite Polarity		Between Live Parts and Grounded Metal Parts, Through Air and Over Surface
	Through Air	Over Surface	
0…150	0.5 in. (12.7 mm)	0.75 in. (19.1 mm)	0.5 in. (12.7 mm)
151…300	0.75 in. (19.1 mm)	1.25 in. (31.8 mm)	0.5 in. (12.7 mm)
301…600	1.0 in. (25.4 mm)	2.0 in. (50.8 mm)	1.0 in. (25.4 mm)(2)
601…1000(3)	1.5 in. (38 mm)	2.5 in. (63 mm)	(4)

(1) An isolated dead metal part, such as a screw head or a washer, interposed between uninsulated parts of opposite polarity or between an uninsulated live part and grounded dead metal, is considered to reduce the spacing by an amount equal to the dimension of the interposed part along the path of measurement.

(2) A through-air spacing of not less than 0.5 in. (12.7 mm) is acceptable.
at a circuit-breaker or fusible disconnecting means
between grounded dead metal and the neutral of a 3-phase, 4-wire motor control center

(3) Applies only to rectified output >600V DC.

(4) Through-air spacing required is 1.5 in. (38 mm); over-surface spacing required is 2.0 in. (50 mm).

Table 8 - Spacing Requirements within MCC Units

Voltage	Min Spacing, in. (mm)		
	Between Uninsulated Live Parts of Opposite Polarity and Between an Uninsulated Live Part and an Exposed or Uninsulated Dead Metal Part other than the Enclosure		Between Uninsulated Live Parts and the Walls of a Metal Enclosure(1), Including Fittings for Conduit or Armored Cable
	Through Air	Over Surface	Shortest Distance
0…150	0.125 in. (3.2 mm) (2)	0.25 in. (6.4 mm)	0.5 in. (12.7 mm)
151…300	0.25 in. (6.4 mm)	0.375 in. (9.5 mm)	0.5 in. (12.7 mm)
301…600	0.375 in. (9.5 mm)	0.5 in. (12.7 mm)	0.5 in. (12.7 mm)
601…1000(3)	0.55 in. (14 mm)	0.85 in (21.6 mm)	(4)

(1) The enclosure refers to the section enclosure.

(2) The spacing between wiring terminals of opposite polarity shall not be less than 0.25 in. (6.4 mm) if the terminals are in the same plane. A metal piece attached to the enclosure shall be considered to be a part of the enclosure for the purpose of this note if deformation of the enclosure is likely to reduce the spacing between the metal piece and a live part.

(3) DC circuits derived from rectified AC circuits without increases to the peak nominal voltage can comply with the electrical spacings of the AC supply voltage.

(4) Through-air spacing required is 0.8 in. (20.3 mm); over-surface spacing required is 1.0 in. (25.4 mm).

Figure 49 - Sample MCC Layout Worksheet

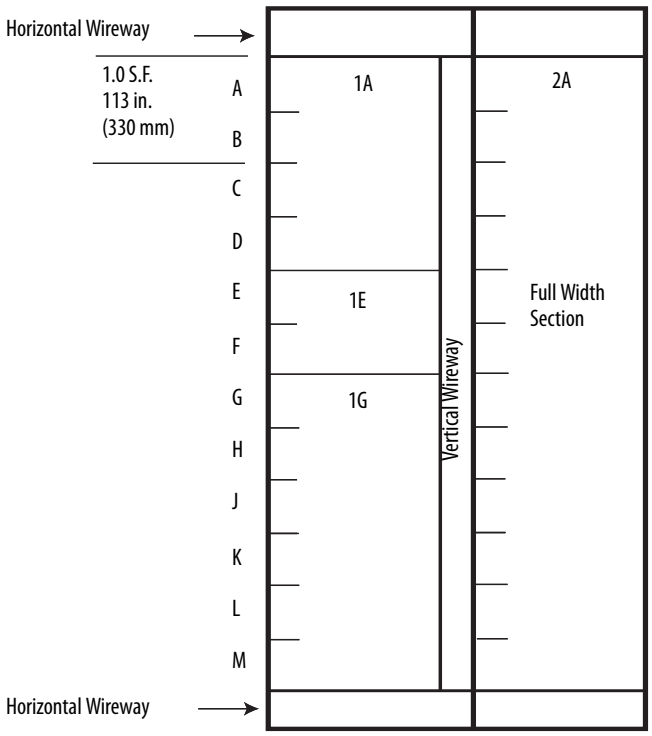


Table 9 - Location of Sample Units within above MCC Layout

Unit Location	Unit Data									
	Cat. No.	Wiring Diagram	Size or Amp Rating	Description	Full Load Current	Horsepower	Overload or Heater Elements	Kilowatts	Circuit Breaker Trip Setting	Power Fuse Rating
1A	2113B-EDB-48CA	CSXXXXXXXX	4	FVNR	77	60	W73	—	C	—
1E	2112A-BDBD-24J-38-7FEC1A	Y-XXXXXX	1	FVNR	4.8	3	7FECIA	—	—	10
1G	2100-NJ30	N/A	—	Blank	—	—	—	—	—	—
2A	2113B-2PAB-56WT	Y-XXXXXX	450A	FVNR(V)	364	250	W43	—	6	—

Table 10 - Unit Description

Unit Type Code	Code Description
CN2DN	ControlNet to DeviceNet
DNC	DeviceNet Connector
DNPS	DeviceNet Power Supply
EN2DN	Ethernet to DeviceNet
FCBX	Insert with Circuit Breaker
FDSX	Insert with Fusible Disconnect
FVLC	Full Voltage Lighting Contactor
FVR	Full Voltage Reversing
FVNR (V)	Full Voltage Non-Reversing (Vacuum)
INSRT	Unit Insert
LPAN	Lighting Panel
(M)BPS	MAIN Bolted Pressure Switch
(M)CB	MAIN Circuit Breaker
(M)FDS	MAIN Fusible Disconnect Switch
(M)LUG	MAIN Line Lugs
METER	Metering Unit
NCP	Neutral Connection Plate
NLD	ControlNet to DeviceNet
PLC	Programmable Logic Controller
RVAT	Reduced Voltage Autotransformer
SMC	Solid State Motor Controller
SPD	Surge Protection Device
TERM	Terminal Unit
TS1W (R)	Two-Speed One Winding (Reversing)
TS2W (R)	Two-Speed Two Winding (Reversing)
VFD (VT)	Variable Frequency Drive (Variable Torque)
VFD (CT)	Variable Frequency Drive (Constant Torque)
VFDR	Variable Frequency Drive Supplemental Unit
XFMR	Transformer

Table 11 - MCC Layout Worksheet

MCC Name / Number _____

	Unit Data									
Unit Location	Cat. No.	Wiring Diagram	Size or Ampere Rating	Description	Full Load Current	Horsepower	Overload or Heater Elements	Kilowatts	Circuit Breaker Trip Setting	Power Fuse Rating

Table 12 - Megger Reading Recording Table

MCC Name / Number _____

Date	Circuit / Unit Name / Number	Phase-to-Phase			Phase-to-Ground			Phase-to-Neutral		
		A - B	B - C	C - A	A - Grd.	B - Grd.	C - Grd.	A - Neut.	B - Neut.	C - Neut.

Notes:

Energizing the Equipment

ATTENTION: This procedure is provided as general guidance for energizing a newly installed CENTERLINE MCC after the Final Check procedure has been completed. See Final Checklist Before Energizing for more information.

ATTENTION: Energizing a MCC for the first time is potentially dangerous. Serious damage and or personal injury can result when power is applied. Therefore, allow only qualified personnel to energize the equipment.

ATTENTION: When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

Energize the Equipment

1. Review any additional instructions supplied for the proper operation of special units such as variable frequency drives and soft starters with appropriate and qualified personnel.
2. Check that there is no load on the MCC when it is energized.
3. De-energize all main and unit disconnect devices.
4. Check to see if any associated remote devices are de-energized.
5. Energize the MCC remote power source.

   ATTENTION: Operate the disconnect-device handles s with a firm, direct motion. Do not 'tease' the handles into the closed (ON/I) position.

6. Energize the main devices followed by the feeder devices and the branch circuit devices.

   Always energize from the source of the system, working towards the loads.
7. After all of the disconnects have been closed, energize loads such as, lighting circuits, motor starters, and contactors.

a. When power-factor correction capacitors are energized with the motor windings and the start-up procedure requires that the respective motors be jogged or inched, temporarily disconnect the power factor correction capacitors.

   For more information on power factor capacitors and MCC units, refer to the Power Factor Correction Capacitors for Bulletin 2100 Motor Control Center Starter Units Application Techniques, publication 2100-AT001.

b. Verify that any acceleration times are within application specifications.

Excessive starting currents and acceleration times can cause inverse time circuit breakers, power fuses, overload relays, and other components to overheat and shut down the equipment.

Maintenance

Establish a periodic maintenance program for MCCs to avoid unnecessary downtime. The frequency of service to the MCC depends on the equipment usage and the operating environment. The following is a suggested checklist and can be used to establish a maintenance program.

ATTENTION: De-energize the MCC before servicing.

Maintain the MCC

1. Inspect the MCCs once per year or per established maintenance program.
2. Carefully inspect doors and enclosure sides for evidence of excessive heat.
3. Check for moisture or any signs of dampness or drippings inside the MCC.

   IMPORTANT Condensation in conduit or dripping from an outside source is a common cause of MCC failure. Eliminate any source of moisture.

   a. Seal off conduit, cracks, and openings that have let and/or could let moisture enter the MCC enclosure.
   b. Dry or replace and clean insulating material that is damp or wet or shows signs of moisture.
   c. Check devices such as contactors, circuit breakers, disconnect switches, relays, and push buttons for wetness or signs of moisture, corrosion, or contamination.
   d. Replace damaged or malfunctioning parts.
4. Check the integrity of bus splice connections.

   Bus splices can be easily identified by the label on the interior of the vertical wireway door or on the interior right-hand side plate of frame mounted units. Recommended torque values can be found on the information label on the interior of the vertical wireway door or on the interior right-hand side plate of frame mounted units.

   The factory-made power bus connections are tightened by a computer-controlled torquing system. The following connections do not require re-torquing, vertical to horizontal bus connections and power conductor to horizontal bus connections. These factory-made connections do not require servicing for the life of the MCC.

5. Periodically clean or replace the air filters depending on the environmental conditions.
6. Check for the proper function and freedom of movement (no sticking or binding) for the disconnect handle operating and defeater mechanisms.
7. Replace broken, deformed, malfunctioning, or badly worn parts or assemblies.
8. Inspect unit bus-stab connections for wear or corrosion.

   Wear and/or corrosion can increase resistance and cause an increased temperature of the contact point, leading to failure. Replace bus stabs if wear or corrosion is excessive. Lubricate bus stabs with NO-OX-ID grease (catalog number 2100H-N18 or 2100H-N18T) before installing the unit into the section.

ATTENTION:

When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

To prevent injury or death to personnel lubricating disconnect switch contacts, make sure the MCC power source(s) is disconnected and the respective disconnect(s) is locked in the OFF/O position. For plug-in units, remove the unit from the MCC.

To prevent personal injury or damage to equipment, make sure that the unit handle operator is in the OFF/O position before removing the unit.

9. Inspect current carrying parts such as fuse clips, knife blades of disconnects, and line and load terminals of devices for discoloration, corrosion, or other signs of wear or possible failure.
10. Check locking or interlocking devices for proper working condition.
11. Adjust, repair, or replace any device if necessary.
12. Check power contacts for excessive wear and dirt accumulation and vacuum or wipe contacts with a soft cloth to remove dirt as needed.

    Contacts are not harmed by discoloration and slight pitting. Never file contacts, as this could reduce the life of the contacts. Do not use contact spray cleaners, as they cause sticking on magnetic pole faces or in operating mechanisms, interfering with the electrical continuity of the contacts. Replace contacts only after the silver has become badly worn. Always replace contacts in complete sets to avoid misalignment and uneven contact pressure.
13. Check for loose wire connections on power and control circuit terminals.

    Loose connections can cause overheating, hot spots, or arcing faults that could lead to equipment malfunction or failure. Replace any damaged parts or wiring.
14. Check contactor and relay coils for evidence of overheating, such as cracking, melting, or burning of insulation.

If there is evidence of overheating, the coil must be replaced. When replacing a coil, check and correct the overvoltage or undervoltage conditions that can cause the coil failure. Be sure to clean any residue of melted coil insulation from other parts of the device and replace as necessary.

15. Check all pilot lights and replace lamps and damaged lenses as necessary.
16. Check all fuses.

    If replacing fuses, install the same type and rated fuse that was originally furnished with the MCC.
17. Remove accumulated dust and dirt from structure and individual units by vacuuming.

    Do not use compressed air, as it can contain moisture and blow debris within the enclosure.
18. Refer to individual user policies, NFPA 70B, Recommended Practice for Electrical Equipment Maintenance for MCC Servicing Guidelines.

Disconnect Switch and Contact Lubrication

ATTENTION:

Follow NFPA 70E safety guidelines when working on energized equipment.

To prevent injury or death to personnel lubricating disconnect switch contacts, make sure any MCC power sources are disconnected and the respective disconnects are locked in the OFF/O position. For plug-in units, remove the unit from the MCC.

To prevent personal injury or damage to equipment, make sure that the unit handle operator is in the OFF/O position before removing the unit.

If a switch that is used frequently becomes difficult to operate or is in a highly corrosive or caustic environment, it can require lubrication. The lubricant to be used is NO-OX-ID Compound (catalog number 2100H-N18 for a 1 pt can or catalog number 2100H-N18T for a 1 oz tube). To obtain the lubricant, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

1. Determine your unit type.

   Plug-in Units

   If a disconnect switch requires lubrication and is housed in a plug-in unit, remove the plug-in unit from the MCC (For removal of unit, refer to 4, Installing and Removing Plug-in Units, before lubricating the switch).

   Frame Mounted Units

   If a disconnect switch requires lubrication and is housed in a frame mounted unit, turn off the power sources to the MCC so the switch can be lubricated.

   ATTENTION: To prevent injury or death to personnel lubricating disconnect switch contacts, make sure that the MCC remote power sources are disconnected and the respective disconnects are locked in the OFF/O position.

   Save all parts for reinstallation.

2. Remove the line guard from the disconnect.
3. For access to the disconnect's stationary contacts, remove the arc hood.
4. Generously apply the NO-OX-ID compound (sufficient enough to cover with a noticeable film) to both sides of the movable contact blades and to the adjacent insides stationary contacts and the hinge.
5. Reinstall the arc hood that was removed in step 3.
6. Reinstall the line guard cover that was removed in step 2.
7. If the lubricated disconnect switch is housed in a plug-in unit, reinstall the unit.

   For installation of unit, refer to Installing Units with Vertical Operating Handles, publication 2100-IN014.

If the unit requires lubrication because of corrosion (for example, a sulfuric environment), replacing the unit disconnect can be required to avoid overheating conditions. Lubrication can temporarily resolve overheating, however replacing the disconnect switch is the ideal, long-term solution.

Use Thermal Infrared or Other Temperature Measurement Techniques for Preventive Maintenance

ATTENTION:

Temperature measuring techniques are often performed with the units fully energized and the doors and covers open.

Use extreme caution when performing these measurements so that energized parts are not shorted.

If care is not taken, electrical shock, severe injury or death can result.

When working on or near energized electrical equipment, follow established electrical safety-related work practices. Refer to NFPA 70E Standard for Electrical Safety in the Workplace.

Use the following procedure when using thermal infrared or other temperature measurement techniques as part of a periodic preventative maintenance program on CENTERLINE 2100 Low Voltage MCCs.

1. Use test equipment to determine the temperature differential and the temperature rise of accessible components within the unit.
2. Determine the services and repair recommendations based on the temperature category in the following guidance chart.

Table 13 - Temperature Guidance

Category	Temperature Differential(1)		Temperature Rise (2)		Repair/Service	
	°C	°F	°C	°F	Service Interval	Recommended Action
1	< 10°	< 18°	< 70°	< 126°	No service or repair required.	See step 1 below.
2	10°...25°	18°...45°	70°...100°	126°...180°	Service or repair the unit at next maintenance schedule (not greater than six months but continue monitoring as a part of preventive maintenance.)	See step 2 below.
3	25°...50°	45°...90°	100°...115°	180°...207°	Service or repair the unit within the next two weeks and monitor the unit at the next maintenance interval.	
4	> 50°	> 90°	> 115°	> 207°	Shutdown the unit and repair. Verify that the temperature is reduced after re-energization.	

(1) Temperature (measured or rise) differential between adjacent phases or like elements. Load between phases must be balanced with a normal variation not exceeding seven percent.

(2) Measured temperature less ambient.
Due to difficulty obtaining accurate infrared temperature measurements from highly reflective surfaces, we recommend using temperature differential readings in determining the Service/Repair guidelines, for example, emissivity of tin or silver plated material.

Inspect the Units for Signs of Overheating

1. If there are no signs of overheating and thermal infrared tests indicate service is not necessary, document the units as acceptable.

   Use this information for reviewing the mean time to maintenance for preventative maintenance for the specific facility.

ATTENTION:

To service the units, make sure that the MCC remote power sources are disconnected and that the respective disconnects are locked in the OFF/O position.

If servicing a plug-in unit, remove it from the MCC to facilitate servicing. Refer to Chapter 2 of this publication for unit removal guidelines.

When plugging units back in, refer to CENTERLINE 2100 Motor Control Centers (MCC) Units with Vertical Operating Handles Installation Instructions, publication 2100-IN014, and CENTERLINE 2100 Motor Control Center (MCC) Units with Horizontal Operating Handles Installation Instructions, publication 2100-IN060.

2. If there are no signs of overheating, but thermal infrared tests indicate service is required, check the power connections for proper torque.
   a. On disconnect switches, service the knife blades with a Scotch-Brite cleansing pad.
   b. Remove all hardened grease.

      Take care not to distort the disconnect jaw (stationary contact).
   c. Lubricate with a fine film of NO-OX-ID (catalog number 2100H-N18 for a 0.47 L (1 pt) can, or catalog number 2100H-N18T for a 29.5 ml (1 oz) tube).

      If the disconnect is subject to environmental conditions causing chronic tarnishing, it can be necessary to determine if there is an incompatibility in the plating material, for example, hydrogen sulfide and silver plating.

      On fuses and fuse clips, service by polishing with a Scotch-Brite cleansing pad. Do not lubricate the fuses or the fuse clips.
3. If overheating has occurred as indicated by severe tarnishing, infrared test results, crystallization of insulation on conductors, discoloration of the components, darkening of the molding materials, brittle conductor insulation, or deformation and melting of parts, replace the components that are suspect.

For more information contact, Rockwell Automation LV MCC Technical Support at 1.440.646.5800 and follow the prompts to Allen-Bradley > Low Voltage Motor Control Centers > Post Shipment Support.

Maintenance after Fault Condition

Maintain the MCC after a Fault Condition

ATTENTION: Make sure that the MCC remote power sources are disconnected and that the respective disconnects are locked in the OFF/O position.

The opening of the short circuit protective device (such as fuses or circuit breakers) in a properly coordinated motor branch circuit is an indication of a fault condition in excess of operating overload and must be corrected.

Fault conditions can cause damage to control equipment. When a fault occurs, follow this procedure.

1. De-energize the MCC.
2. Investigate the cause of the fault and inspect all equipment thoroughly per NEMA Standards publication ICS 2.3-1995, Instructions for the handling installation operator and maintenance of MCCs not rated more than 600V, Section 11, Maintenance after a Fault has Occurred.
3. Make necessary repairs to units, components and structures as required, prior to reenergizing the equipment.

Be sure that replacement parts are suitably rated for the application.

An insulation resistance test (megger) can be required. Refer to Chapter 7.

Notes:

Renewal Parts

A Renewal Parts Stocking Program for MCCs is recommended in conjunction with a maintenance program. This is important for minimizing expensive downtime and to be able to facilitate critical repairs.

Factors to consider when developing an effective Renewal Parts Stocking Program include the following:

- The frequency of ON-OFF cycling and the amount of ON or operating time.
- The need for items such as continuous operation, inherent design limitations, and environmental considerations.
- The total number of similar devices supplied as original equipment within the MCC.
- Individual user policies governing spare parts.

Consider stocking complete units when the job site is in an area remote from a distributor or district sales office or when it is critical to maintain continuous operation of a system.

Order Information

The following information is required when ordering renewal parts:

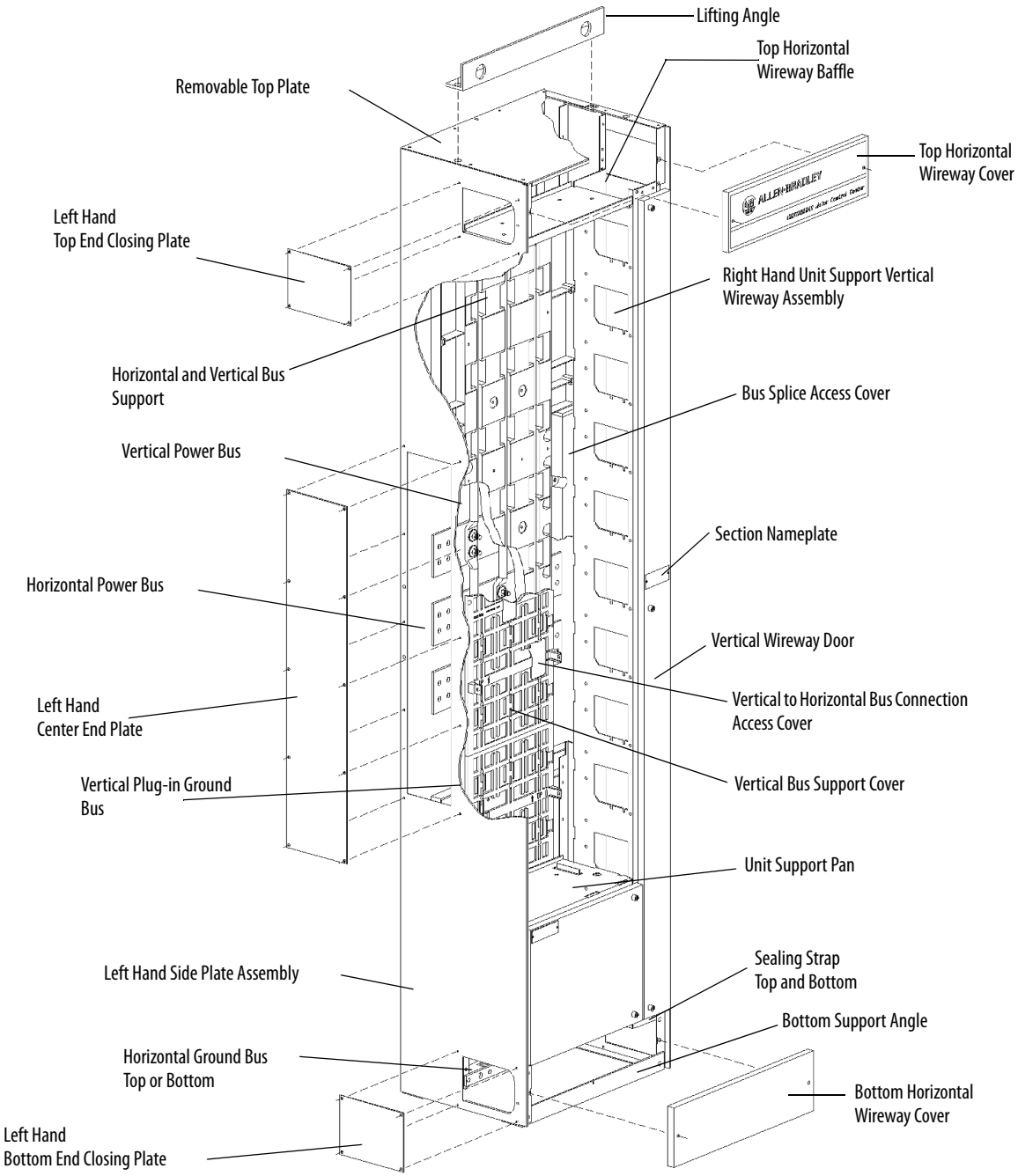
- Description of part or unit
- Series letter
- Part or catalog number
- Quantity
- Shipping address
- MCC serial number and complete nameplate data

Refer to Chapter 12, Parts Illustration, for pictures and descriptions of common section and unit parts.

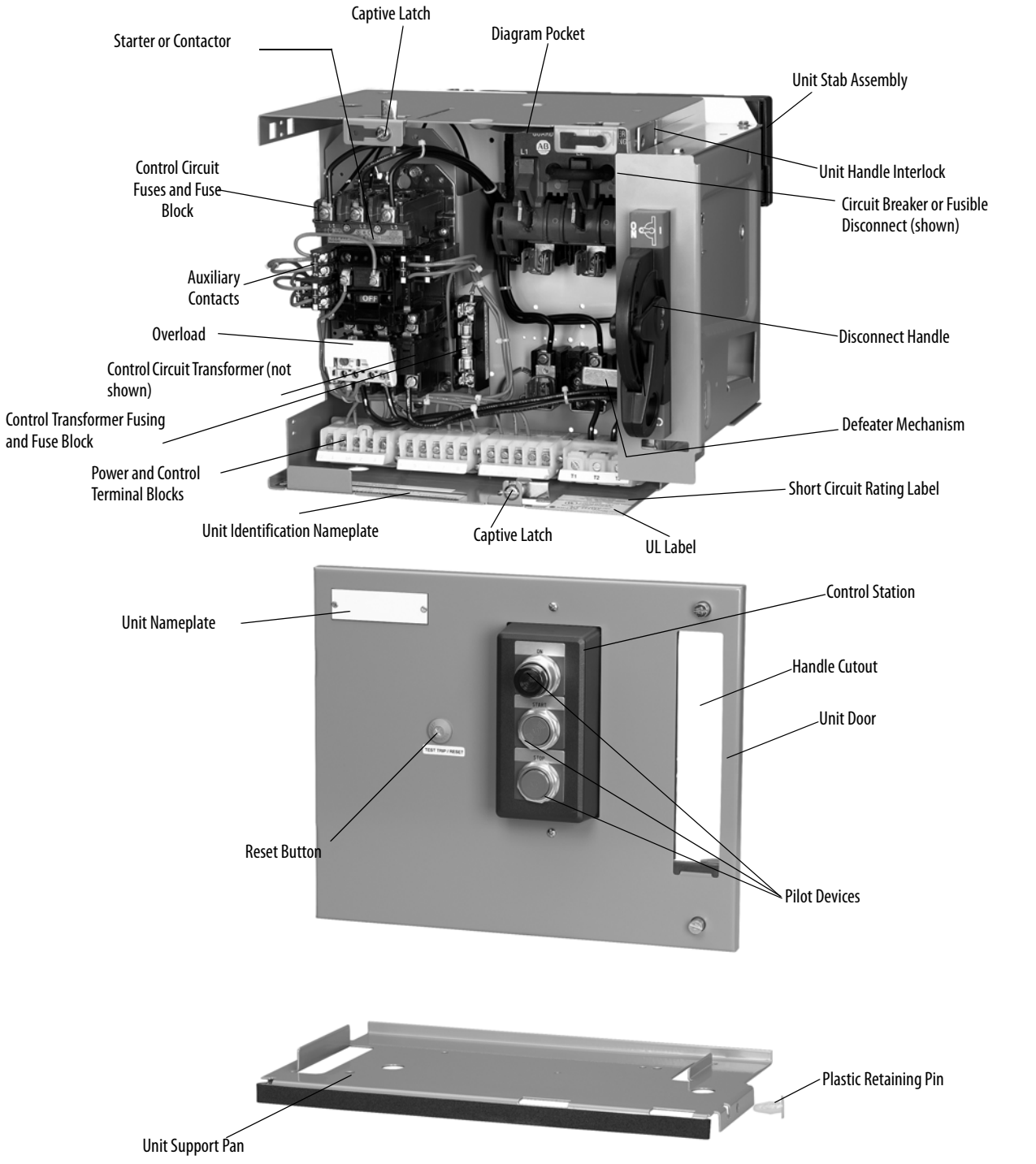
Notes:

Parts Illustrations

Typical Section Construction

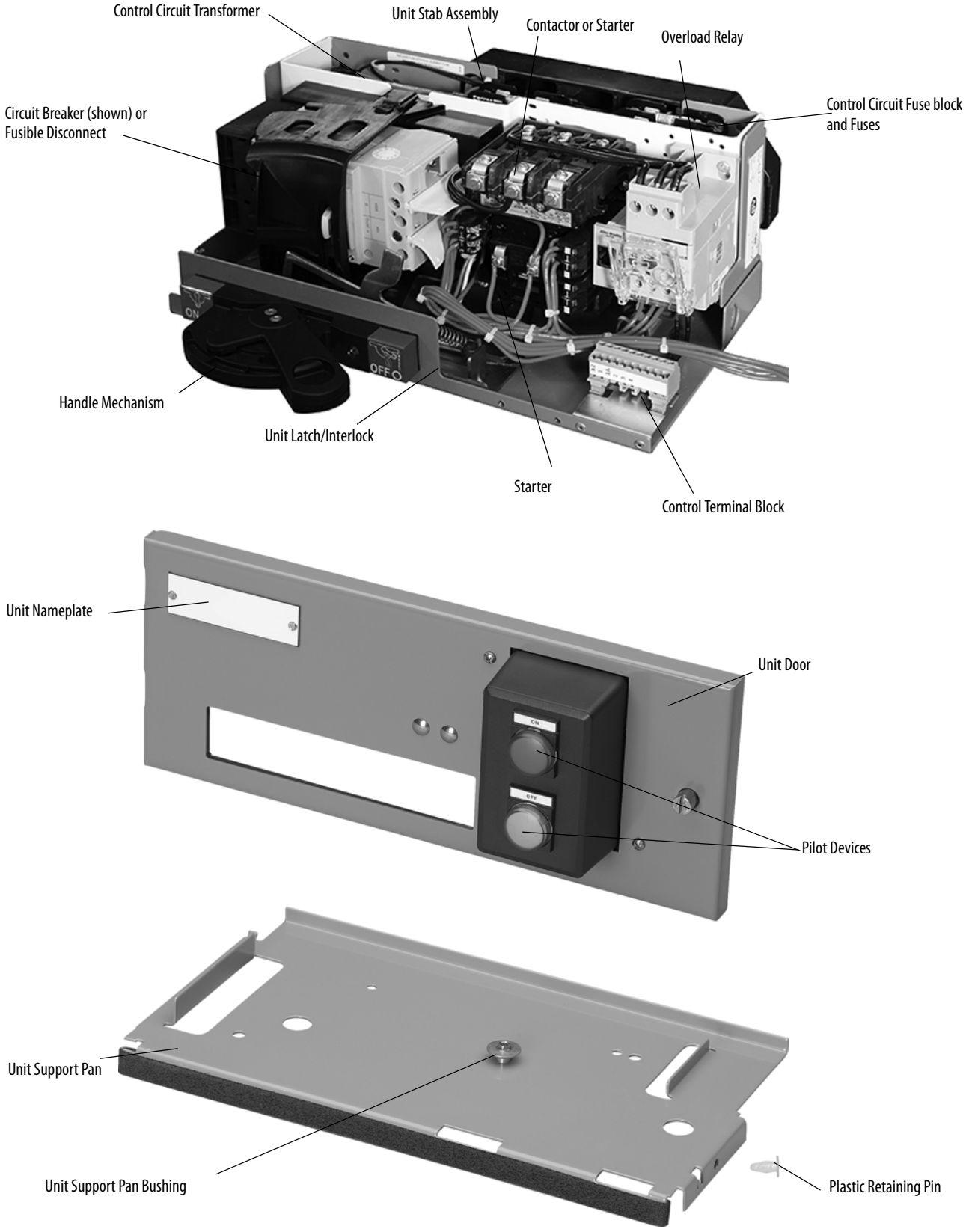

Lifting Angle
Top Horizontal Wireway Baffle
Removable Top Plate
Top Horizontal Wireway Cover
Left Hand Top End Closing Plate
Right Hand Unit Support Vertical Wireway Assembly
Horizontal and Vertical Bus Support
Bus Splice Access Cover
Vertical Power Bus
Section Nameplate
Horizontal Power Bus
Vertical Wireway Door
Left Hand Center End Plate
Vertical to Horizontal Bus Connection Access Cover
Vertical Plug-in Ground Bus
Vertical Bus Support Cover
Unit Support Pan
Left Hand Side Plate Assembly
Sealing Strap Top and Bottom
Bottom Support Angle
Horizontal Ground Bus Top or Bottom
Bottom Horizontal Wireway Cover
Left Hand Bottom End Closing Plate

Typical Construction of a Unit with a Vertical Operating Handle

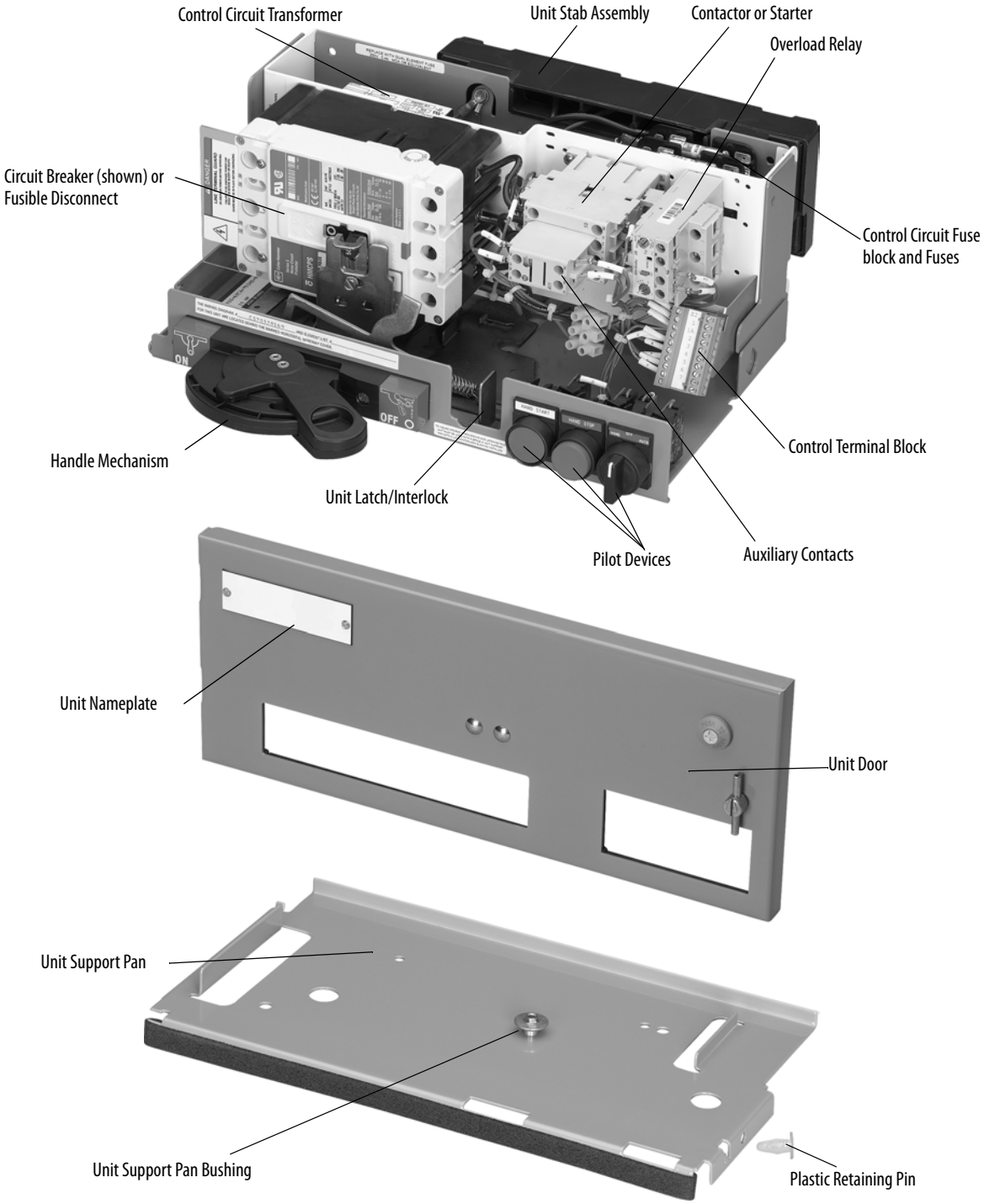


Bulletin 2112, Size 1, FVNR with Transformer Shown

Typical Construction of a Half Space Factor Unit with a Horizontal Operating Handle and Door Mounted Pilot Devices



Typical Construction of a Unit with a Horizontal Operating Handle



Bulletin 2413, IEC Style Shown

Bulletin 140G Unit Assembly Instructions

Vertical Handle Units

These procedures show how to install, verify, and adjust a Bulletin 140G circuit breaker in a vertical handle unit. Some items of the unit are not shown in the illustrations for clarity.

Required Tools

You need a screwdriver, a Phillips screwdriver, a socket set with extension, and a torque wrench to complete the installation.

Install Circuit Breaker

Follow these steps to install the Bulletin 140G circuit breaker in a vertical handle unit.

1. Attach the handle assembly to the mounting plate by using #10-32 x 0.38 thread-forming screws and tighten to 20...40 lb•in (2.25...4.50 N•m).
2. If optional external auxiliary contacts are used, attach the external auxiliary bracket (not included in the kit) to the circuit breaker base.

IMPORTANT	Keep the base flat during assembly; do not support it on the side. Keep the left screw on the bracket base loose to adjust the bracket later.

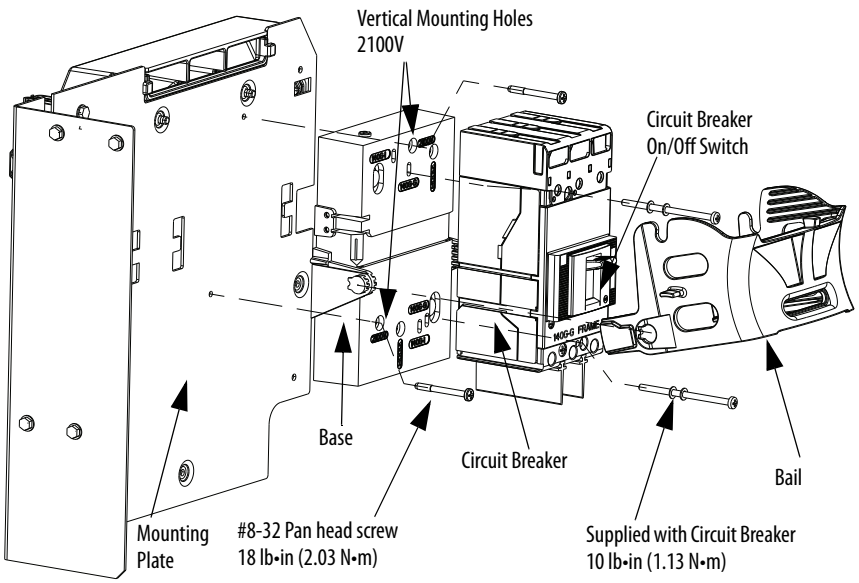
3. Position the base on the mounting plate.

   Use the vertical mounting holes (2100V).
4. Mount the base to the mounting plate by using #8-32 x 1.62 Pan head screws (G frame units); #8-32 x 0.81 Pan head screws (H and J frame units).
5. Tighten to 18 lb•in (2.03 N•m).

   TIP The wires from internal accessories on the right side of the circuit breaker are routed under the circuit breaker in the 'trough' in the base so they exit on the left.
6. Mount the circuit breaker to the base by using screws (included with the circuit breaker), split lock washers, and flat washers (use washers from the existing unit).

The circuit breaker and the mounting plate are not included in the repair kit.

7. Tighten to 10 lb•in (1.13 N•m).

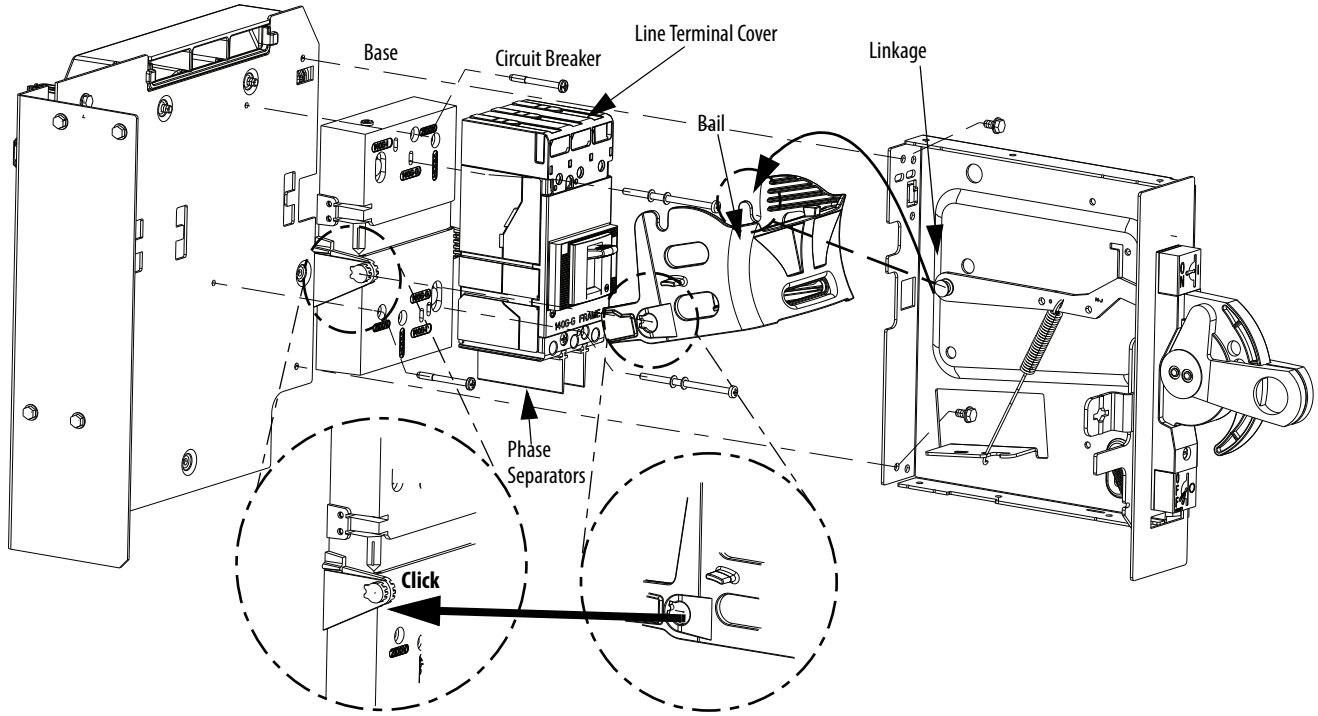


8. Put the circuit breaker ON/OFF switch to the 'ON' position.
9. Install the bail on to the circuit breaker base.

IMPORTANT The circuit breaker must be in the 'ON' position to install the bail.

The bail snaps into place on both sides of the circuit breaker base. (If the bail does not snap in easily, check the orientation of the bail.)

10. Move the circuit breaker/bail to the 'OFF' position.
11. Engage the linkage to the bail.



TIP If wired accessories are included in the circuit breaker, route accessory wires under the circuit breaker in the 'trough' in the base.

Verify that all accessory wires exit on the left side of the assembly, above the bail connection point. Use wire ties to avoid tangled wires in the unit.

12. Verify that the circuit breaker operates correctly.

    See Verify Operation and Adjust Circuit Breaker Position.

13. Snap the auxiliary contacts to the bracket.
14. Attach the line-side wiring and tighten to 53 lb•in (6 N•m) for G and H frame units; tighten to 71 lb•in (8 N•m) for J Frame units.
15. Add the line terminal cover to the line side (not included in the kit).
16. Insert the terminal cover screw (not provided with the kit), and tighten to 8 lb•in (0.90 N•m).
17. Attach the load-side wiring and tighten to 53 lb•in (6 N•m) for G and H frame units; tighten to 71 lb•in(8 N•m) for J frame units.
18. Install the load side phase separators on the load side (not supplied with the kit).

    Verify that the phase separators are pushed down completely so that they are flush with the cover.

Verify Operation

1. Make sure the circuit breaker/bail is in the 'ON' position, push the 'Trip' button on the circuit breaker, and observe that the toggle on the circuit breaker and the switch on the handle have moved to the tripped position.
2. Attempt to move the handle from the tripped position to the 'OFF' position and back again to 'ON' to verify reset of the circuit breaker.

   If the handle does not move to the 'ON' position, adjust the circuit breaker position and retry the trip sequence.

Adjust Circuit Breaker Position

Follow these steps to adjust the circuit breaker position.

1. Loosen the two circuit breaker mounting screws.
2. Turn the adjustment screw on the top of the base assembly to the right (clockwise) to move the circuit breaker higher in the unit.

   Turn the adjustment screw on the top of the base assembly to the left to lower the circuit breaker in the unit.

   TIP The adjustment distance is limited. If you feel resistance when you turn the adjustment screw (and you confirmed that you have already loosened the circuit breaker mounting screws), you have reached the adjustment limit.

3. If optional external auxiliary contacts are used, after the external contacts have been snapped on, adjust the auxiliary bracket until the bail contacts the plunger on the front contact when in the 'ON' position and tighten to 20 lb•in (2.25 N•m).
4. Tighten the two circuit breaker mounting screws to 10 lb•in (1.13 N•m).

Horizontal Handle and Space Saving Design

These procedures show how to install, verify, and adjust a Bulletin 140G circuit breaker in a horizontal handle unit. Some items of the unit are not shown in the illustrations for clarity.

Required Tools

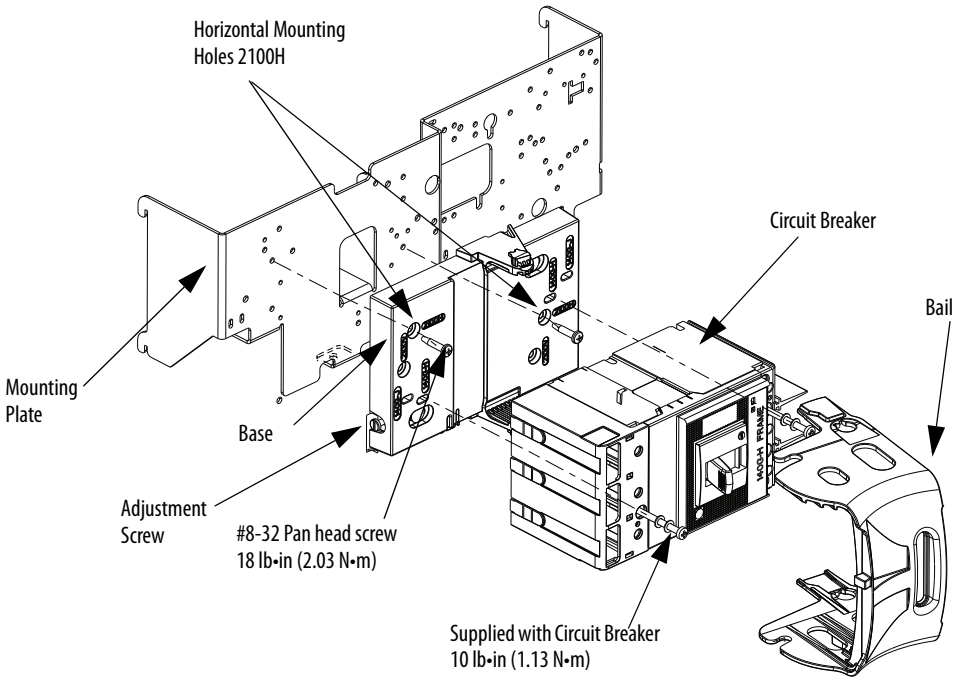
You need a screwdriver, a Phillips screwdriver, a socket set with extension, and a torque wrench to complete the installation.

Install Circuit Breaker

Follow these steps to install the Bulletin 140G circuit breaker in a horizontal handle unit.

1. Mount the circuit breaker base to the mounting plate by using #8-32 x 1.62 Pan head screws (G frame units); #8-32 x 0.81 Pan head screw (H and J frame units).

   Use the horizontal mounting holes (2100H).
2. Tighten to 18 lb•in (2.03 N•m)
3. Mount the circuit breaker to the base by using screws(included with the circuit breaker), split lock washers, and flat washers (use washers from the existing unit)and tighten to 10 lb•in (1.13 N•m).

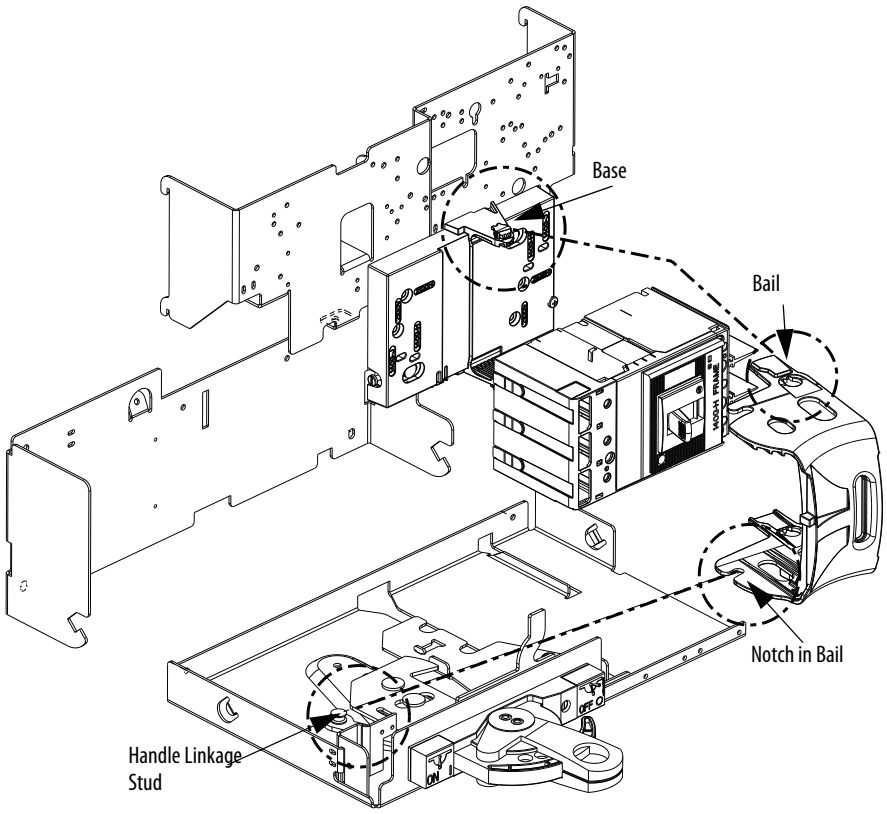


4. Put the circuit breaker ON/OFF switch to the 'ON' position.

5. Install the bail on to the circuit breaker base.

IMPORTANT The circuit breaker must be in the 'ON' position to install the bail.

The bail snaps into place on both sides of the circuit breaker base. (If the bail does not snap in easily, check the orientation of the bail.)



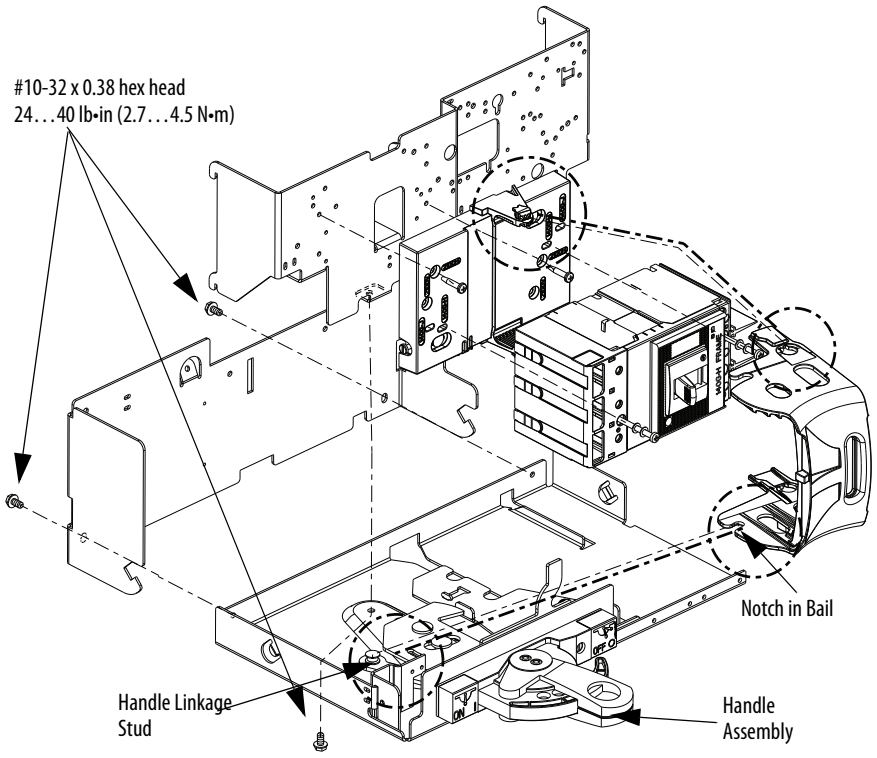
6. Attach the line-side wiring and tighten to 53 lb•in (6 N•m) for G and H frame units; tighten to 71 lb•in (8 N•m) for J Frame units.
7. Add the line terminal cover to the line side (not included in the kit).
8. Insert the terminal cover screw and washer (not provided with the kit), and tighten to 8 lb•in (0.90 N•m).
9. Attach the load-side wiring and tighten to 53 lb•in (6 N•m) for G and H frame units; tighten to 71 lb•in (8 N•m) for J frame units.
10. Install the load-side phase separators on the load side (not supplied with the kit).

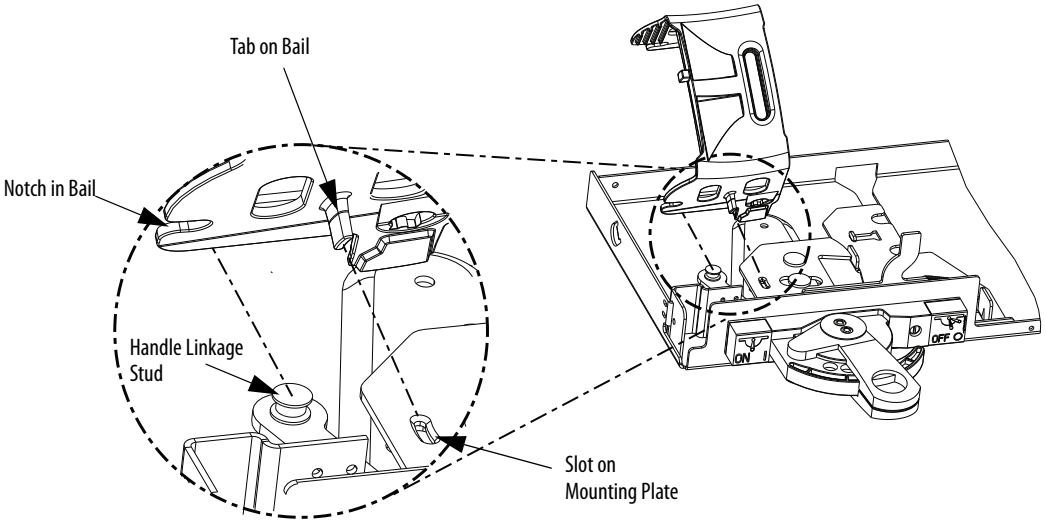
    Verify that the phase separators are pushed down completely so that they are flush with the cover.

11. Attach the handle assembly to the base plate by using #10-32 x 0.38 hex head thread-forming screws and tighten to 24...40 lb•in (2.7...4.5 N•m).

12. With the handle in the 'OFF' position, align the tab on the bail with the slot in the mounting plate and secure with a #10-32 x 0.38 hex head thread-forming screw.

13. With the handle and the circuit breaker in the 'OFF' position, engage the linkage to the notch in the bail.





14. Attach the external auxiliary contacts to the bracket.

Verify Operation

1. Make sure the circuit breaker/bail is in the 'ON' position, push the 'Trip' button on the circuit breaker, and observe that the toggle on the circuit breaker and the switch on the handle have moved to the tripped position.
2. Attempt to move the handle from the tripped position to the 'OFF' position and back again to 'ON' to verify reset of the circuit breaker.

   If the handle does not move to the 'ON' position, adjust the circuit breaker position and retry the trip sequence.

Adjust the Circuit Breaker Position

Follow these steps to adjust the circuit breaker position.

1. Loosen the two circuit breaker mounting screws.
2. Turn the adjustment screw on the top of the base assembly to the right (clockwise) to move the circuit breaker higher in the unit.

   Turn the adjustment screw on the top of the base assembly to the left to lower the circuit breaker in the unit.

   TIP The adjustment distance is limited. If you feel resistance when you turn the adjustment screw (and you confirmed that you have already loosened the circuit breaker mounting screws), you have reached the adjustment limit.

3. After the external contacts have been snapped on, adjust the auxiliary bracket until the bail contacts the plunger on the front contact when in the 'ON' position and tighten to these values:
   - 32 lb•in (3.62 N•m) for #8 screws
   - 18 lb•in (2.0 N•m) for #6 screws
4. Tighten the two circuit breaker mounting screws to 10 lb•in (1.13 N•m).

Notes:

Auxiliary Contact Adapters

Use these instructions to install an external auxiliary contact adapter in CENTERLINE 2100 Series Z and later units with circuit breakers (Bulletin 140G and 140MG).

The auxiliary contact kits are to be used with the following auxiliary contacts: catalog numbers 800F-X10, 800F-X01, 800F-X20D, 800F-X11D, and 800F-X02D.

ATTENTION: De-energize all of the power sources to the motor control center before installing the auxiliary contact adapter. Failure to de-energize all of the power sources can result in severe injury or death.

Install External Auxiliary Contact Adapter on G, H, and J Frame Horizontal Units

Follow these instructions for installing auxiliary contacts on G, H, and J frame horizontal units.

These kits contain parts to install external auxiliary contacts in units that are the following types:

- Units with horizontal operating handles
- Have one of the following circuit breakers: Bulletin 140G, 140MG
- Bulletin 2100 Series Z and later

ATTENTION: De-energize all of the power sources before installing auxiliary contact. Failure to de-energize all of the power sources can result in severe injury or death.

Required Tools

You need a screwdriver, a Phillips screwdriver, and a hexalobular T-15 screwdriver to complete the installation.

Install the Auxiliary Contact Adapter

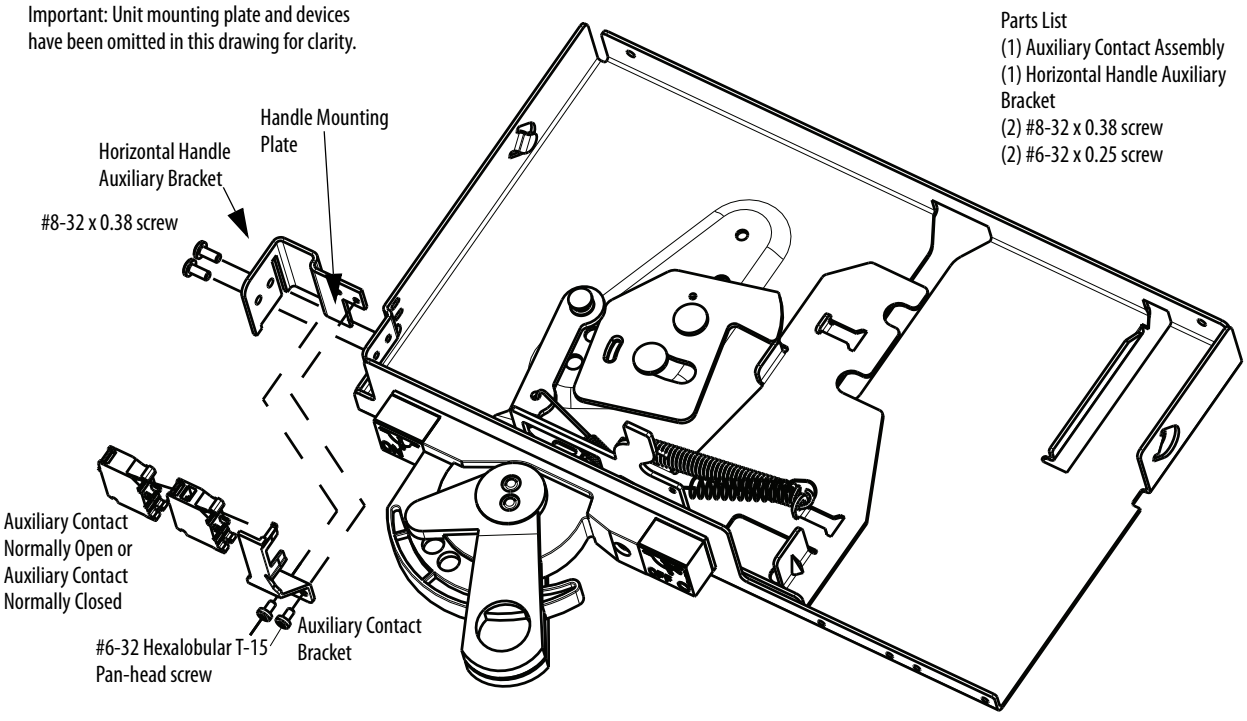
Follow these steps and refer to Assembly of External Auxiliary Contact Parts to install the auxiliary contact adapter.

TIP These external auxiliary contacts are actuated by the unit operating handle only, and do not reflect a circuit breaker trip

1. Remove the unit from the section before attempting to install the auxiliary contacts.

   For instructions on removing the unit, refer to Remove a Plug-in Unit with a Horizontal Operating Handle from a Section on page 57.
2. Verify the parts list, see Assembly of External Auxiliary Contact Parts.
3. Attach the auxiliary contact assembly to the handle mounting plate by using two #6-32 x 0.25 hexalobular T-15 pan-head screws.
4. Attach the horizontal handle aulilary bracket to the unit by using two #8-32 x 0.38 thread forming screws.
5. Tighten to these values:
   - 32 lb•in (3.62 N•m) for #8 screws
   - 18 lb•in (2.0 N•m) for #6 screws
6. Turn the operator handle to the ON/I position to verify that the auxiliary contacts change state.
7. Check continuity to verify proper operation of the auxiliary contacts.

Figure 50 - Horizontal Units


Important: Unit mounting plate and devices have been omitted in this drawing for clarity.
Parts List
(1) Auxiliary Contact Assembly
(1) Horizontal Handle Auxiliary Bracket
(2) #8-32 x 0.38 screw
(2) #6-32 x 0.25 screw
Handle Mounting Plate
Horizontal Handle Auxiliary Bracket
#8-32 x 0.38 screw
Auxiliary Contact Normally Open or Auxiliary Contact Normally Closed
#6-32 Hexalobular T-15 Pan-head screw
Auxiliary Contact Bracket

Install External Auxiliary Contact Adapter on G, H, J, and K Frame Units

Follow these instructions to install an external auxiliary contact adapter in Bulletin 2100 Series Z or later units with circuit breakers (Bulletin 140G and 140MG). The instructions are the same for single and dual units.

This auxiliary contact kit is to be used with the following auxiliary contacts: Catalog numbers 800F-X10, 800F-X01, 800F-X20D, 800F-X11D, and 800F-X02D.

TIP De-energize all of the power sources to the motor control center before installing auxiliary contact adapter. Failure to de-energize all of the power sources can result in severe injury or death.

Required Tools

You need a screwdriver, a 1/4” wrench or socket, a 5/16” wrench or socket, and a torque wrench.

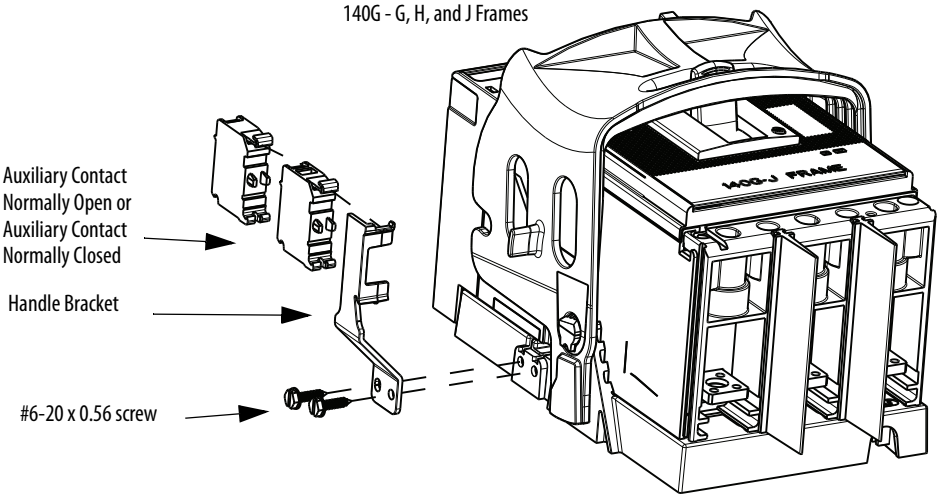
Installation

Refer to Figure 51 and use the following steps to install external auxiliary contact adapter.

1. Make sure that all of the power has been disconnected.
2. Verify the parts list.
3. Install auxiliary contacts.
4. Attach the external auxiliary contact assembly to the mounting plate by using one #8-32 x 0.38 inch thread-rolling screw.
5. Tighten to these vaules:
   - 20 lb•in (2.2 N•m) for #6-20 screws
   - 32 lb•in (3.6 N•m) for #8-32 screws
6. Check continuity to ensure proper operation of auxiliary contacts.

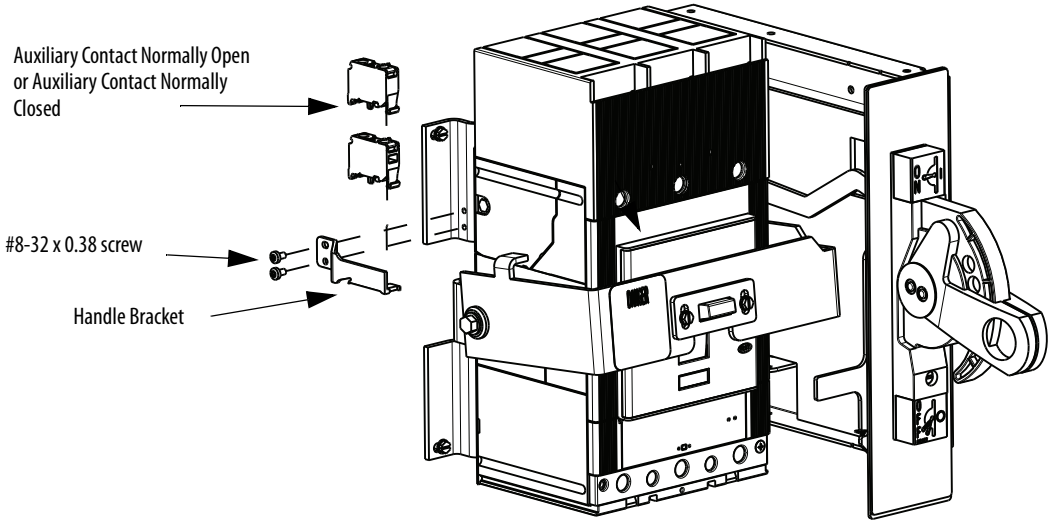
Figure 51 - External Auxiliary Contact Adapter on G, H, J, and K Frame Units

140G - G, H, and J Frames



Parts List
(1) Auxiliary Contact Assembly
(1)Handle Bracket
(2) #8-32 x 0.38 screws,
or
(2) #6-20 x 0.56 screws

140G - K Frames



Install External Auxiliary Contact Adapter on M and N Frame Units

Follow these instructions for installing the auxiliary contact adapters on M and N frame units.

Required Tools

You need a socket set with extension and a torque wrench to complete the installation.

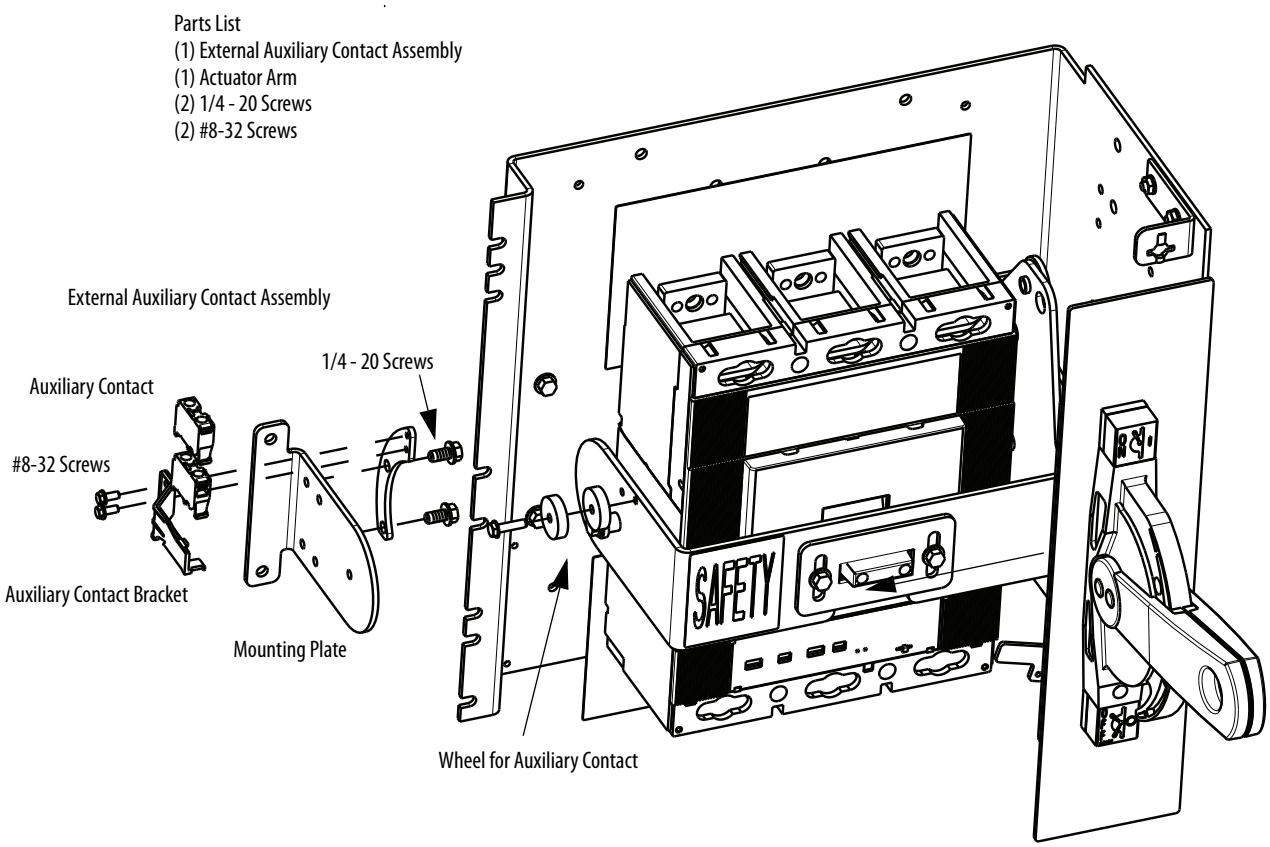
Install the Auxiliary Contact Adapter

Follow these steps and refer to Assembly of External Auxiliary Contact Parts to install the auxiliary contact adapter.

1. Verify that all of the power has been disconnected and turn the operator handle to the OFF/O position.
2. Verify the parts list, see Assembly of External Auxiliary Contact Parts.
3. Attach the external auxiliary contact assembly to the mounting plate by using two 1/4-20 thread-rolling screws and tighten to 55 lb•in (6.2 N•m).

   Refer to Assembly of External Auxiliary Contact Parts.
4. Attach the actuator to the circuit breaker bail by using two 1/4-20 thread-rolling screws.
5. Position the actuator so the screws are centered in the slots and tighten to 55 lb•in (6.2 N•m).
6. Install the auxiliary contacts (catalog numbers 800F-X10, 800F-X01, 800F-X20D, 800F-X11D, and 800F-X02D).
7. Turn the operator handle to the ON/I position to verify that the auxiliary contacts change state.
8. Check continuity to verify proper operation of auxiliary contacts.

Figure 52 - Assembly of External Auxiliary Contact Parts



Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 2100-IN012F-EN-P - January 2015
Supersedes Publication 2100-IN012E-EN-P - February 2012

Copyright © 2015 Rockwell Automation, Inc. All rights reserved. Printed in the U.S.A.